PUBLIC HEALTH ASPECTS OF DIABETIC THERAPY

Thesis for the Degree of M.D.
University of Glasgow

by

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C O N T E N T S

PREFACE

This thesis embodies the experience which the author gained in organising and conducting a diabetic clinic at the Western Infirmary of Glasgow and research work which was undertaken at that clinic.

Part I deals with the need for a public diabetic service in the treatment of poorer patients and its organisation. The establishment of such a clinic might not be considered original work, but this specialised type of clinic was a novel departure at the above institution, new ground had to be opened up and unforseen obstacles overcome. Much experience was thus gained which would be of value to others embarking on a similar task. Since leaving the Western Infirmary I have been engaged in Public Health work and am now able to view the treatment of this disease from both the voluntary hospital and public health administrative aspects.

In Part II are set forth investigations carried out during the tenure of a Carnegie Research Scholarship and while I was in charge of the clinic.

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PART I

CHAPTER I

INTRODUCTION

Diabetes Mellitus was, until recent years, regarded as a relatively rare disease. During the past three decades its occurrence has been much more frequent and since the discovery of insulin it has taken quite a prominent place in the medical world.

Tables I and II, the figures of which have been calculated from the Registrar General's Statistical Reviews of England and Wales for the years 1911 - 1937, show that, while the general death rate has definitely decreased and that due to tuberculosis has been reduced by fully 50%, the diabetic death rate has increased by over 60%. Similar findings have been noted by Defries and his co-workers (1) in Ontario for the years 1909 - 1937. In New York Tiber (2) found at the Bellevue Hospital that the percentage of deaths due to diabetes during the period 1911 - 1916 was 0.95% compared with 2.1% in the years 1929 - 1934. The corresponding percentages for New York City were 1.26% and 2.63%. Diabetics constituted 2.8 per 1,000 admissions to the above hospital in the earlier period, while during the later period this proportion was 9.7 per 1,000. The general admissions to the hospital had increased by 44.6% and the diabetic by 395%. Lemann (3) reports that in the New Orleans Charity Hospital from 1909 - 1919 diabetics

TABLE I

Statistics for whole of England & Wales

Year	Persons Death Rates per 100,000			% of all deaths due to Diabetes	Ratio of deaths due to tuberculosis to those due to Diabetes
	All Causes	Tuberculosis	Diabetes		
1911	1458	147	10.6	0.73	13.8
1912	1338	138	11.1	0.83	12.4
1913	1379	135	11.8	0.85	11.5
1914	1398	136	12.2	0.87	11.2
1915	1590	154	13.2	0.82	11.7
1916	1473	156	13.2	0.89	11.9
1917	1480	166	11.3	0.76	14.7
1918	1828	173	10.7	0.58	16.3
1919	1370	126	10.5	0.76	12.0
1920	1242	113	10.0	0.80	11.3
1921	1211	113	10.8	0.89	10.4
1922	1277	112	11.9	0.99	9.4
1923	1158	106	11.4	0.98	9.3
1924	1221	106	11.0	0.90	9.7
1925	1215	104	11.2	0.92	9.1
1926	1162	96	11.5	0.99	8.3
1927	1233	97	12.6	1.0	7.7
1928	1166	93	13.1	1.12	7.1
1929	1344	96	14.2	1.06	6.8
1930	1144	90	14.2	1.24	6.3
1931	1229	90	14.5	1.18	6.2
1932	1204	84	15.2	1.26	5.5
1933	1230	82	15.6	1.27	5.3
1934	1190	76	16.0	1.3	4.8
1935	1175	72	16.4	1.4	4.4
1936	1214	69	17.4	1.44	4.0
1937	1242	70	17.8	1.43	3.9

T A B L E II

Year	Death Rates from Diabetes per 100,000 England & Wales		Masculinity of Diabetic Deaths $\frac{\text{Male D}}{\text{Female D}}$ x 1000
	Male	Female	
1911	11.1	10.3	1010
1912	11.7	10.6	1039
1913	12.0	11.6	969
1914	12.6	11.8	997
1915	14.6	12.0	1005
1916	15.4	11.4	1039
1917	13.7	9.6	1022
1918	12.9	9.0	1007
1919	11.0	10.0	968
1920	9.9	10.1	887
1921	10.5	11.1	869
1922	11.6	12.2	863
1923	10.5	12.2	790
1924	10.2	11.8	804
1925	9.8	12.5	713
1926	10.6	12.4	779
1927	10.9	14.2	704
1928	11.6	14.5	738
1929	12.2	16.1	694
1930	12.1	16.1	693
1931	11.8	17.0	636
1932	12.7	17.6	658
1933	12.7	18.2	644
1934	12.9	18.9	628
1935	13.0	19.6	610
1936	13.9	20.7	622
1937	14.2	21.0	623

were admitted in the proportion of 1.2 per 1,000 general admissions compared with 3 per 1,000 between 1921 and 1926. The percentage of all deaths due to diabetes, in England and Wales (Table I), has become doubled during the period under review (1911 - 1937).

In 1911 deaths from all forms of tuberculosis were almost fourteen times as frequent as those due to diabetes, but by 1937 the proportion had dropped to less than 4 to 1 (Table I), a reduction of 72%. In New York City during 1931 there were 2,000 deaths from diabetes compared with 5,000 from tuberculosis and 8,300 from cancer (4), while in the United States Registration Area in 1932 the tuberculosis death rate was 63 per 100,000 and that of diabetes 22 per 100,000 (5). The increasing importance of diabetes mellitus as a cause of death is thus manifest.

When the sexes are considered separately it is seen (Table II) that by far the greater increase in death rate is among females. Since 1918 the masculinity of deaths has fallen steadily. Table III, which gives the deaths by age and sex for the years 1911 and 1936, shows that this increase is mainly in women of 45 years and over, the death rate having decreased in the younger age groups, while in males there has been a definite decrease in mortality except at ages over 55 years, where an increase has taken place. Graham (6), working on average death

TABLE III

MALES

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age Group	Population 1911	Diabetic Deaths 1911	Diabetic Death Rate per 100,000 1911	Population 1936	Expected Diabetic Deaths 1936 4 x 5 ÷ 100,000	Actual Diabetic Deaths 1936
All Ages	17,490,847	1936		19,591,000	2972	2731
0 -	1,941,280	11	0.57	1,423,500	8.065	9
5 -	1,852,192	22	1.19	1,501,300	17.832	11
10 -	1,752,176	36	2.05	1,667,000	34.249	25
15 -	1,659,169	67	4.04	1,624,700	65.608	23
20 -	1,506,574	71	4.71	1,644,200	77.486	30
25 -	2,839,154	157	5.55	3,319,600	183.567	81
35 -	2,342,549	183	7.81	2,641,400	206.346	70
45 -	1,698,638	252	14.84	2,328,500	345.442	226
55 -	1,087,813	461	42.38	1,919,400	813.414	614
65 -	604,220	512	84.74	1,093,000	926.178	1058
75 -	207,082	164	79.20	371,500	294.211	583

TABLE IIIA

FEMALES

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age Group	Population 1911	Diabetic Deaths 1911	Diabetic Death Rate per 100,000 1911	Population 1936	Expected Diabetic Deaths 1936 4 x 5 ÷ 100,000	Actual Diabetic Deaths 1936
All Ages	18,672,986	1917		21,248,000	3032	4388
0 -	1,923,455	9	0.47	1,377,000	6.0	7
5 -	1,854,463	24	1.29	1,471,100	19.038	14
10 -	1,756,672	41	2.33	1,635,000	38.160	20
15 -	1,686,089	49	2.91	1,595,100	46.356	31
20 -	1,677,365	40	2.38	1,698,400	40.502	33
25 -	3,132,701	155	4.95	3,487,600	172.559	79
35 -	2,515,851	162	6.44	3,113,700	200.496	142
45 -	1,838,513	261	14.20	2,738,900	388.821	324
55 -	1,216,197	470	38.65	2,205,200	852.200	1094
65 -	759,419	512	67.41	1,338,600	902.483	1771
75 -	312,261	194	62.13	587,400	364.937	873

rates over a ten year period, has obtained similar results. It was found in England and Wales in 1928 (7) that since the introduction of insulin the mortality from diabetes of males under 55 years had fallen by 37% and that of females by 21%. In U.S.A. from 1923 till 1933 the probability of dying from diabetes had been increased by 50% for baby girls and 15% for baby boys (5). It is interesting to note that Bolduan (8) found that among unmarried persons over 45 years of age the diabetic death rates were the same for both sexes in the years 1931 and 1932. Pregnancy may, therefore, play some role in the preponderence of females in the upper age groups.

Diabetes is a disease of middle and late middle life. Table IV shows the age and sex distribution of diabetics consulting me for the first time at the diabetic clinic of the Western Infirmary, Glasgow between November 1933 and March 1936. The proportions are set forth graphically in Figure 1, and it is apparent that the maximum incidence is in the age group 55 -.

TABLE IV

Age Group	5 -	15 -	25 -	35 -	45 -	55 -	65 -	75 - 85
Males	5	12	16	16	22	26	9	1
Females	3	12	15	30	41	76	28	2
Total	8	24	31	46	63	102	37	3

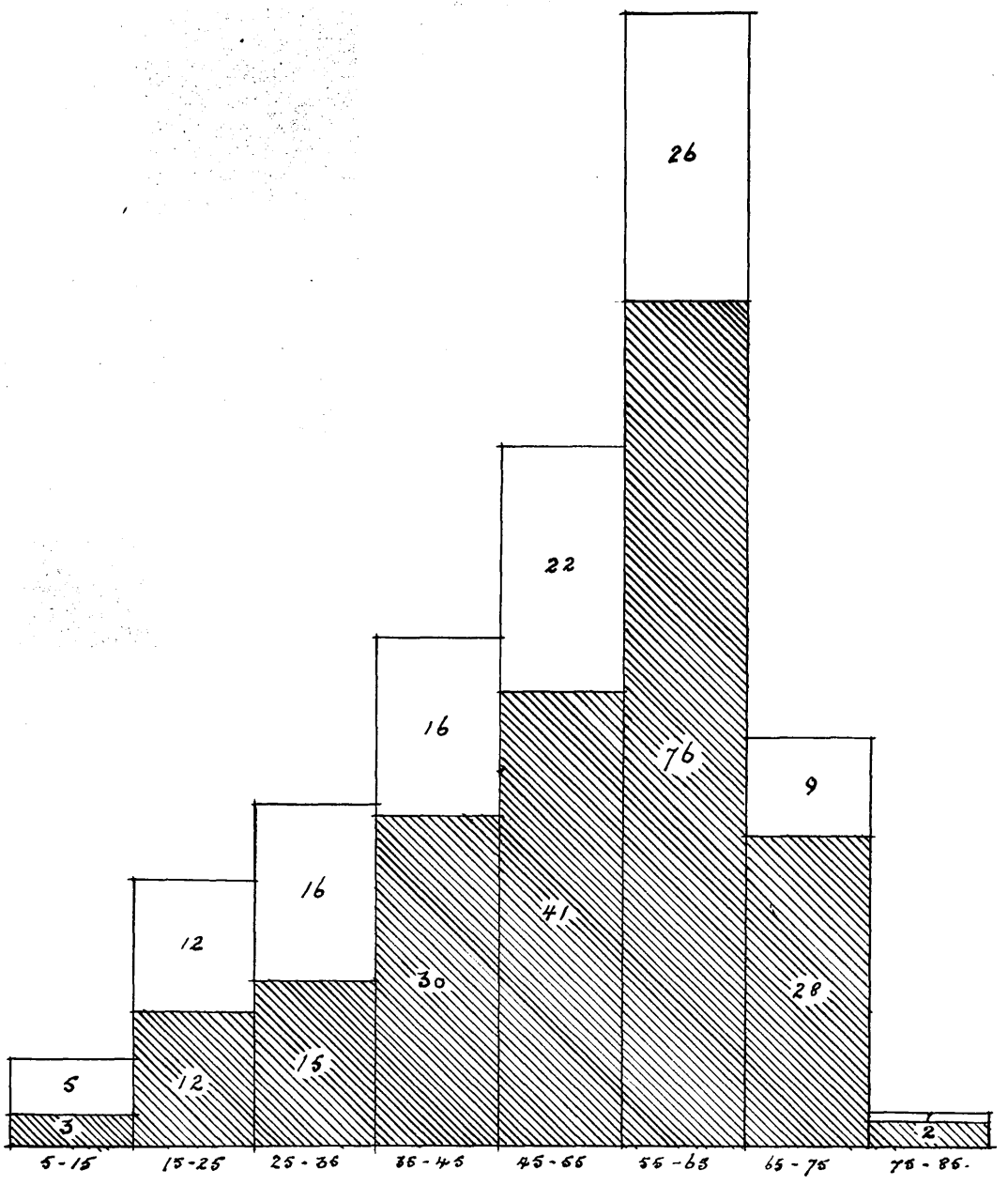


Figure 1

Histogram showing the number of males, clear columns, and the number of females, shaded columns, in the various age groups who attended the Western Infirmary Diabetic Clinic.

This is in accord with the observations of American workers (9), who show that the maximum susceptibility to diabetes is in the sixth decade - 51 years among males and 55 years among females. They find a declining susceptibility in old age and this is in accord with the ages of persons seeking treatment at the Western Infirmary, Glasgow. Mosenthal (10), however, regards diabetes as a senile degeneration, but I cannot agree with this view on the etiology of the disease. In Australia a similar age distribution of the disease is noted. Of 487 diabetics treated at the Coast Hospital, Sydney, 71% were over 40 years of age before the onset of diabetes (11).

The populations of this country and U.S.A. have been aging and it is possible that this, associated with the usual age incidence of the disease, might account in part at least for the increase in diabetic mortality. It was accordingly decided to calculate the expected deaths in 1936, the year when the percentage of all deaths due to diabetes was highest, if the 1911 rates had operated.

Tables 3 and 3A set forth the population, diabetic deaths and death rates from that disease according to age and sex for 1911, and the population, actual and expected diabetic deaths for 1936. In the case of males the total expected deaths exceeds the actual by 241. Closer investigation reveals that apart from the age

group under 5 years the expected deaths exceed the actual in all ages till 65 years, after which the actual is greater than the expected mortality. Among females, on the other hand, the actual deaths exceed the expected by 1356. In the age group under 5 years the actual is greater than the expected number of deaths, but in all subsequent groups under 55 years the reverse is the case. From 55 years onwards the actual deaths far exceed the expected. The greater proportion of deaths take place in the older age groups, but this is not due solely to the altered age and sex distribution of the population. The death rate from diabetes per 100,000 for females aged 55 to 60 was 38.65 in 1911 and 49.61 in 1936. The corresponding figures for ages 65 to 75 were 67.41 and 132.3; the expected deaths in persons amount to 6,004 and the actual 7119. That is, there was apparently a real increase in diabetic mortality in the country as a whole. In New York City an increase of 58% in the age standardised diabetic deaths has been noted between 1901 and 1931 (12). The statistics of the Industrial Department of the Metropolitan Life Insurance Company, after compensation for age, sex and colour distribution of the population, show that the death rate is steadily rising (5). Rabinowitch (13) regards the rising death rate as more real than apparent. Bolduan (14) on the other hand does not consider that

there is any real increase in diabetes apart from the aging of the population, but as stated above, I am not in agreement with this observation.

The reason for this increase in diabetes has been attributed to various factors. Deaths of diabetics from other causes may, in the absence of properly completed death certificates, be erroneously attributed to diabetes. In U.S.A. diabetes is given preference if it appears on the death certificate (14), and Hekimian and Vogel (15) refer to this by way of explanation for part of the rise in mortality from diabetes. In this country deaths by violence and diseases included in groups 1, 2 and 3 of infectious, parasitic and general diseases of the international list of causes of death as adopted for use in England and Wales, Scotland and Northern Ireland, take precedence over diabetes, but even then the same possibility exists. One would however expect this error to operate at all ages and not merely in the upper age groups. Other observers (16) maintain that in U.S.A. recorded mortality represents $\frac{4}{5}$ of true mortality as measured by joint causes of death and about $\frac{2}{3}$ of mortality of individuals with diabetes.

Increased frequency in diagnosis of the condition may play a not inconsiderable part in making the disease appear to be on the increase. The number and ability

of doctors and the number of hospital beds seem to govern the frequency of diabetes mellitus (17). In the New York Hospital, routine examination of urine was not instituted until 1890 (8). Many diabetics would, under these circumstances, be undetected, and thus reduce the number of deaths attributed to that disease.

Routine examinations for insurance and employment purposes have brought to light many unsuspected cases. Bolduan (14) goes as far as to state that this caused the former preponderence of diabetes among males, but only 15.9% of Joslin's male patients were discovered under these circumstances (17), and among my hospital patients who belonged to the poorer classes about 2% were so discovered. The position is, of course, much different in private practice. My experience in a diabetic clinic showed that many of the patients, the majority of whom were females, had consulted their medical advisers on account of diabetic symptoms, complications or intercurrent disease and that routine medical examinations played a very small part in the diagnosis of diabetes among the hospital classes.

It is well known that many diabetics are obese before the onset of the disease, and numerous workers regard obesity as a predisposing cause. Bolduan (18) on the other hand states that from records of clothing manufacturers there has been no general increase in obesity to account

for increased incidence of diabetes. Joslin and his co-workers (17) maintain that lighter work, labour saving devices and increased buying power of the people cause diabetes by favouring overweight, and Dorlet (12) expresses the same view. The fact that those with high per capita incomes tend to buy diets with relatively high fat is well recognised. and if the incidence of diabetes in private practice is examined it is found very frequently in those who partake of a liberal quantity of fat. In a hospital clinic one is apt to encounter a large number of poor diabetics, but this does not give an index of the occurrence of the disease in the population as a whole.

The increase in diabetes has been shown to take place in the older age groups, and at these ages the incidence of the disease rises with the social class (7). It would therefore appear that diet plays some role in the etiology of the condition, and Bolduan (4) maintains that a high diabetic death rate is associated with high sugar consumption, but Joslin and his co-workers (19) hold the view that there is no relation between the two, and I am in agreement with the latter view.

Towards the end of the Great War the death rate fell in those countries which were subjected to blockade. In Britain the submarine blockade started in 1917, and in 1918 the percentage of all deaths due to diabetes

was the lowest recorded (Table I). A similar fall was noted in Germany (20) and (4). The food shortage was mainly in fat and the diet had to be made up by the consumption of extra starchy foods. If excess dietary carbohydrate had been a cause of the increased diabetic death rate a fall in this would not have been experienced. The admirable researches of Himsworth, and Himsworth and Marshall (21) (22) and (23), confirm that it is not the increase in carbohydrate but rather the lack of it which may be a contributory factor in the etiology of the disease.

Heredity also plays some part in the etiology of diabetes. Pincus and White (24) point out that diabetes may be transmitted as a Mendelian recessive. If we assume that potential diabetics are subject to the usual causes of death and expectation of life before developing this disease the Mendelian expectations are satisfied. The greater length of life now enjoyed would, under these circumstances, enable a number of potential diabetics, who would formerly have died from other causes, to live to an age when diabetes would develop. This may in part account for the marked increase in deaths in the older age groups.

Whatever the cause of the rising mortality from diabetes the fact remains that there is an increased incidence of the disease and consequently a large number of patients

to be cared for. The advent of insulin has greatly increased the span of life of the average diabetic subject. According to a life table constructed on Joslin's patients the expectation of life of a diabetic child of 10 years has been increased by 30 years (25) and he maintains (26) that the number of diabetics in the community is increasing partly because the individual diabetic is living longer. This is bourne out by Hajek (27) who found that the average age at death of diabetics in the pre-insulin and early insulin eras was 55 years, whereas in the late insulin period it was 59.8 years, and by Flynn (28) who gives the average duration of diabetes at death as 4.1 years in the period 1913 - 1922 and 5.1 years between 1923 - 1933. Joslin and his associates (19) state that the average duration of diabetes at the time of death is 10 years. This time appears long compared with Flynn's observations, and it may be that many of the patients included in Joslin's survey attended his own clinic and were thus under ideal supervision.

If the 1937 diabetic death rate for England and Wales is taken and we assume a duration of the disease of 10 years before death, then in a community of 100,000 people there would be 180 diabetics. Grote (20) quotes figures from an actual census in Stettin reported on by Gottschalk. This town, with a population of 268,000

inhabitants, had 640 diabetics, giving an incidence rate of 237 per 100,000, which is in excess of the estimated number of diabetics in this country on the above assumption. Unfortunately it is not possible to carry out actual enumerations of patients in different localities, and I know of no other actual census of diabetics having been taken for purposes of comparison.

It is evident from these observations that there is in our midst a large number of diabetics; with modern treatment and a co-operative patient there is no reason why the expectation of life of these individuals should not be very good indeed and why there should be loss of time from work. My experience at a diabetic clinic has shown that after control has been established diabetics can continue their work without interruption, and because of the fine moral fibre which they develop and their regular habits they make, to my mind, very desirable employees. Other workers (29) have had similar experience. It is unfortunate that employers, in some instances, have been slow to realise this. These diabetics are in many instances active members of the community, have families and are very valuable citizens. Lack of treatment or inadequate treatment may result in invalidism, and in the working classes the patient and his or her family, if young, may become a charge to the state and valuable

lives may even be lost. That such a state can exist is a disgrace to modern civilisation and unfortunately it does exist. At a diabetic clinic patients occasionally came under observation where in spite of symptoms of several months duration only the most meagre attempt at treatment had been made. Flynn (28) reports that 58% of fatal hospital cases in elderly people had never had insulin prior to admission to hospital. Of 456 persons classified as dying from diabetes in Ontario only 270 had received medical care (1). It has been reported from the diabetic clinic of Edinburgh Royal Infirmary that in 21 or 14% of 150 fatal cases death had resulted from improper treatment outside the institution (30).

Joslin (31) states that the expectation of life of a diabetic child of 10 years is 31.7 years and it is therefore deplorable for one to die during the first or second decades of diabetes. He writes "The death of a single child from diabetic coma signifies pure and unadulterated neglect and nothing else." Yet we are all aware that children do die of diabetic coma. Many diabetic deaths are preventable.

This disease was the twenty-seventh cause of death in U.S.A. at the beginning of the century, in 1933 it was the tenth cause (5), and it is now responsible in England and Wales for a number of deaths equal to a quarter of

those due to tuberculosis. Surely such a disease is a public health concern.

In the large cities there are already many well organised clinics offering excellent treatment for diabetics, but in our rural areas and smaller towns such facilities are lacking. Numerous patients are thus without adequate treatment or receive it only at great personal inconvenience and expense. Many of my hospital diabetics had to pay fares of over 3/- each time they visited the clinic while others could only have special examinations when they were visiting friends in town as the expense was otherwise prohibitive. It is consideration of these facts which has prompted me to put on record my experience in the organisation of a diabetic clinic together with the researches which I conducted while in charge of it.

CHAPTER II

The Treatment of Diabetics in the Community.

What is the best way in which to tackle the treatment of this ever growing diabetic community? There are, naturally, the private practitioners who, as indicated before, are generally the first to see the patient. They might tackle the treatment with the aid of the general hospitals for the very severe and complicated cases. Dunlop and Pybus (32) suggest that all diabetics can be treated by the general practitioner, and Joslin (26) maintains that it is a disease to be treated by the family physician. Grote (20) on the other hand holds that the family doctor is not equal to the constant necessity of controlling the diabetic patient and that the cost of treatment to the masses is reduced when the work is undertaken by a public health welfare authority, while Young and Russell (33) cast doubts as to whether practitioners and patients are making the best use of insulin. Singer (34) states that to make diabetics attend clinics all the time would clash with the private interests of physicians. While one has no intention of taking practice from private doctors, the well being of the diabetic community must have precedence over all other considerations.

When I was conducting the diabetic clinic at the

Western Infirmary some neighbouring general practitioners spoke highly of the service it rendered and how it was filling a much felt want in the district. They stated that they were quite unable to devote adequate time to the treatment of their diabetic patients.

Table V shows the percentage of patients referred to the clinic after treatment in the wards, from the out-patient department and directly from their private practitioners for the years 1934 - 35.

TABLE V.

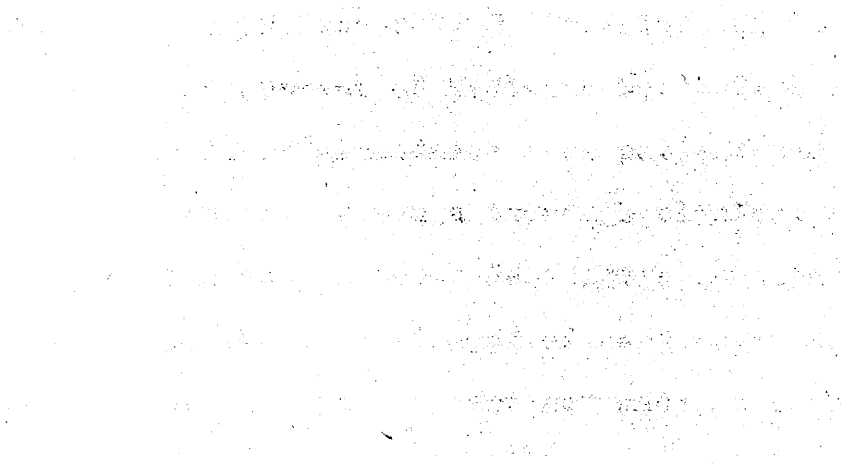
Year	From Wards	From Out Patient Department.	From Private Doctors
1933	67.7%	27%	5.3%
1934	36.2%	41.3%	22.5%
1935	26.3%	27.6%	46.1%

Many of the patients from the out-patient department were poor and unable to consult a private doctor, and others had been sent to that department by doctors who were unaware of the existence of a special clinic. It is obvious from the table that general practitioners were making increasing use of the service offered by the clinic and that bed accommodation in the wards was thereby being saved; all patients from the wards were automatically sent to the clinic.

The difficulty of treating diabetics in general practice was further brought home to me some years later when I looked after the practice of a friend who had been taken ill. He had a few diabetics under his care and he made a special request that I should visit them. I found that, in spite of my special experience, I was in the same position as the family practitioner. The many demands on my time and lack of facilities precluded my giving these patients the attention and instruction I was in the habit of giving to the clinic patients. The conclusion was then forced upon me that, for the patient who cannot afford specialist fees, the solution of the problem lies in the diabetic clinic. This involves not the exclusion of the family practitioner but rather a high degree of co-operation with him. When details of investigation and treatment were sent from the Western Infirmary Clinic to the doctor it was suggested that the patient should attend regularly for supervision. The suggestion was generally welcomed by the practitioner and when changes in treatment were necessary he was notified accordingly, and it was usually he who made any necessary local arrangements for insulin supply and administration.

It has been advocated that the private practitioner should conduct the treatment and send specimens to the

laboratory for blood sugar and other estimations. Such specimens must be obtained under known standard conditions if the findings are to be of value, and the interpretation of the results of such analyses is, in some cases, by no means easy. It is my opinion that the interpretation should be made by the person under whose care the test is executed, and the general practitioner should not be expected to possess specialist knowledge. He wishes help with his diabetics and the clinic should furnish this in a material form and not merely return him a series of probably meaningless figures.



CHAPTER III

The Clinic as a Diagnostic Centre

In 1933 I was asked by the Medical Superintendent of the Western Infirmary, Glasgow to organise a dietetic clinic for the after care of diabetics and other petients discharged from that institution. As is pointed out in a succeeding chapter, the clinic soon began to deal with new cases of diabetes and so provision for the investigation of suspected cases of diabetes had to be made. The necessity for this diagnostic service is evident from the fact that of 370 patients, suffering from glycosuria, who were seen at the clinic 45, or 12%, did not suffer from diabetes but had renal glycosuria or lag storage curves. The facilities for biochemical investigations were afforded me in the Clinical Laboratory by Professor C. H. Browning and in the University Department of Medicine by Professor T.K. Monro.

At his first attendance each patient had an accurate history taken, was given a thorough clinical examination and the urine was tested. Benedict's qualitative solution was used for the detection of urinary sugar and quantitative estimations were not made as such procedures occupy much time and afford little material help with diagnosis or treatment. Rothera's nitroprusside and the ferric chloride tests were employed for the detection of

ketone bodies. On the findings thus obtained a clinical diagnosis of diabetes mellitus could frequently be made and the presence of complications detected. Those with glycosuria, ketonuria and typical symptoms might have been put on treatment without further investigation, but as many of them were being subsequently used for research purposes the diagnosis was in each case confirmed by blood sugar examinations. If, for example, in a clinic serving a landward area, such blood analyses could only be carried out at great inconvenience to the patient I should not hesitate to dispense with them in typical cases. Lawrence (35) is in agreement with this, and he also maintains that quantitative determination of urinary sugar is quite unnecessary.

The preliminary examinations having been completed, an appointment was made for the patient to attend at the Clinical Laboratory for blood sugar examinations. Experience showed that where a subject had been on a restricted diet the sugar tolerance was not infrequently poor and in one such case, a man aged 49 years, the fasting blood sugar was 0.13 mgm.%, the post-prandial level exceeded 0.2 mgm.% and the sugar level did not return to normal in two hours. At the time I wrongly regarded him as a mild diabetic and prescribed diet accordingly. He subsequently developed vertigo, and

on reviewing his case and repeating my investigations I found that he suffered from innocent glycosuria but had been on a restricted diet prior to my first investigation. Lawrence and McCance (36) state that carbohydrate starvation may produce a diabetic type of blood sugar curve, and the work of Himsworth (21), (22) and (23), throws further light on this subject. Leyton (37) states that hyperglycaemic glycosuria is not necessarily diabetes and he reports five cases (38) where a diagnosis of diabetes was made on the strength of glucose tolerance tests in the absence of symptoms and in which the subsequent history and further tests did not bear out this diagnosis. He does not state, however, whether there had been marked dietetic restrictions prior to the original investigations. Patients were accordingly instructed to take a normal diet until the day appointed for the examination when they reported at 9.15 a.m. in the fasting state. Samples of blood and urine were obtained, 50 grammes of glucose dissolved in a glass of water and suitably flavoured were administered, and 1½ hours after this drink had been consumed further samples of blood and urine were taken. The necessity of travelling before the examination is, strictly speaking, undesirable, as the exercise tends to increase carbohydrate utilisation and so disturb the test, but in a large series of cases

I found no evidence to justify routine admission to hospital for such investigations. The two test method does not give the amount of information a full blood sugar curve would yield, but in the great majority of cases these estimations furnished sufficient evidence to enable a diagnosis to be made. I had no technical assistance in the execution of these analyses and it was therefore impossible to attempt full glucose tolerance tests in the time which I could devote to this part of the work. The urine was examined for the presence of sugar, and the glucose in 0.2 ml. blood was estimated by a modification of the Folin Wu method (39) which was found very suitable when a large number of specimens had to be handled. The necessity of a colorimeter is a disadvantage in this method. Where such an instrument cannot be procured one of the titration methods of analysis, such as Maclean's (40), can be employed.

It is a good plan to set aside one day each week for this work. If the apparatus is prepared on the previous evening the investigation of six patients can be completed during the morning, and diet sheets may then be drawn up and letters written to the patients' private practitioners. Such an arrangement ensures smooth running of the clinic and prevents unnecessary delay in the institution of treatment.

The cost of the above investigations should not be great. It is, of course, uneconomic to employ highly paid personnel on work which could be adequately undertaken by a technical assistant. Most hospital and public health laboratories have such technicians, or if no such assistant were available a nurse or dietitian could be easily trained. One of the dietitians at the Western Infirmary soon learned to carry out these analyses with extreme accuracy although she had not previously had experience of such work. The necessary chemicals can be purchased ready for use from the larger drug houses, but I preferred to make up my own solutions. With the exception of the colorimeter the apparatus required is inexpensive.

The diagnostic service above described gives some idea of what should be aimed at by a small clinic. There is no need for a centre in a small town to be equipped for all varieties of chemical analyses, which would be seldom if ever employed. The cost of such a scheme is not beyond the means of the average large Burgh in Scotland or urban district in England.

CHAPTER IV

The Clinic as a Treatment and Welfare Centre.

The treatment of diabetes does not end with the prescription of diet and insulin. Cognisance must be taken of many factors which may directly or indirectly influence the patients' health and happiness and which may therefore render him an asset or a liability to the community of which he is a member. With these observations in view the various factors affecting clinic organisation and treatment are discussed below under their appropriate headings.

I.

Should all Diabetics have preliminary Treatment in Hospital?

It was formerly the custom to admit most patients to hospital or nursing home as soon as diabetes was suspected. When the Western Infirmary Clinic was started this principle was adhered to, but the fact soon became obvious that many patients referred to hospital lost valuable weeks of treatment while they awaited admission to the wards. It was therefore decided to treat the milder cases as outpatients. The results were so encouraging that soon all patients except those with complications or severe forms of

the disease were so treated. Few children attended the clinic, but it was found much more satisfactory to admit them to the wards for preliminary treatment. Professor Morris (41) advocates this procedure in the case of children. Earl (42) treats mild cases only at a diabetic clinic, but Lawrence (43) maintains that all diabetics apart from coma cases and children can be so dealt with.

The treatment of such patients without admission to hospital results in a considerable saving of accommodation and funds to the institution, especially when it is considered that up to a short time ago diabetes took third place as regards length of stay in hospital (20). Moreover, it was observed that many patients referred to the clinic from the wards required rebalancing of the diet and insulin shortly afterwards. In order to investigate the frequency of this occurrence 162 consecutive cases were observed after discharge from the wards. Fifty-seven, or 35%, required to be rebalanced. Not only does this absorb time, but it causes the patient to lose confidence in the treatment, and in many of these the cost of the stay in hospital has been wasted.

While in hospital the patient leads an unnatural existence and does not take part in his usual activities.

It is only natural that a diet and insulin dosage which suited him under these circumstances may entirely fail when he returns to his home and his work with the resulting alteration in expenditure of physical and mental energy. In addition, even though well instructed in dietetics and in the administration of insulin while in hospital, on discharge the patient and his family have for the first time to tackle these problems unaided. It is therefore not sirprising that breakdowns occasionally occur. When a diabetic is treated from the start at the clinic it may take longer to get the urine sugar free and the blood sugar brought within normal limits, but the balance has been attained under the conditions of his normal existence and subsequent breakdown is thus rendered less likely.

In view of the above findings taxation of hospital accommodation by the admission of cases of uncomplicated diabetes does not appear justifiable. The decision to admit a patient to hospital should properly be left in the hands of the clinic medical officer.

II.

Continuity of Supervision of the Diabetic.

Whether the patient is admitted to hospital and then referred to the clinic for supervision or attends the clinic from the first it is highly desirable that

there should be continuity of treatment. The post of medical officer should, therefore, be a permanent position and the practice of leaving the supervision to resident medical officers who will be changed at six-monthly or yearly intervals should be avoided. Apart from the temporary nature nature of these appointments, such medical officers would not possess sufficient experience and would be leaving as soon as they had gained proficiency in running of the clinic.

It is very helpful if the medical officer of the clinic has charge of beds in the hospital to which he can admit cases requiring indoor treatment. At the Western Infirmary I had not charge of beds, but Professor Monro allowed me to supervise the treatment of patients admitted to his wards, and the surgeons in charge of the "septic wards" in which were treated cases of gangrene and septic conditions, among whom there was a number of undetected diabetics, generally asked me to control the medical treatment and prepare the patient for operation. This co-operation proved very effective in the control of the disease. Where no such co-operation existed it would be difficult to prevent the patient from being the sufferer.

III.

The Keeping of Clinic Records.

No clinic can be successfully conducted unless there is an adequate system of keeping the record of each patient. These records must be accurate, concise and easily kept. A system which involves turning over pages of journals and reading through copious manuscripts can have no place in a busy clinic.

Up till recently the Western Infirmary adhered to the book system of keeping records, and this method was naturally used in the dietetic clinic. As the clinic increased in size the system proved slow and cumbersome and a special filing system was evolved. Each patient had a folder containing a case sheet and a progress chart and the folders were filed in alphabetical order.

The case sheet, which was of foolscap size, was headed with the patient's particulars and subheadings for history, symptoms, signs, and the examination of the various systems were set out below this. In practice this sheet was not as successful as one had hoped it to be, and I should now advise one with merely the patient's name and address, etc. and his doctor's name, address and telephone number.

A progress chart is of great importance. The one devised at the clinic was of foolscap size and was ruled lengthwise. All the findings at any one visit could be recorded on a single line under the appropriate headings. The exact state of the patient and the treatment could be seen at a glance and the recording of the findings was very simple. Columns ruled off on the chart set forth in tabular form:

(1) the date (2) the weight

(3) the results of examination of a 24 hour specimen of urine

(4) the findings in specimens of blood

(5) the diet in grammes of:

Carbohydrate (C)
Protein (P) and
Fat (F) and
the total Calories per day

the balance of the diet in four columns marked:

Breakfast (B)
Dinner (D)
Tea (T) and
Supper (S)

If Lawrence Line diets were being used the number of lines for each meal could be inserted, and if other systems were in use marks could be made to indicate at which meals most food was taken for future reference when prescribing insulin.

(6) The amount of insulin before breakfast, dinner, tea and supper, and the total.

(7) Date of next attendance

(8) Remarks

There were blank columns included under the headings of urine and blood examinations which could be used for particular investigations. Special notes could be made on the reverse side with an appropriate reference under remarks. The chart was capable of holding the record of thirty visits to the clinic.

The above chart fulfilled its purpose exceedingly well and I never had reason to consider any alterations to its layout. Joslin (26) is in favour of a chart of this type, and Morris (41) used a similar chart in his diabetic clinic.

Records of future appointments were made in a diary so that those failing to attend could be readily detected. To prevent confusion each patient had a clinic card on which was marked the date when he was next due to attend.

IV

Dietetic Treatment through the Clinic.

The particular method of dieting employed will naturally depend on the views of the physician in charge of the clinic. How the patient is instructed regarding his diet is equally as important as the

exact number of Calories prescribed. As will be shown in a subsequent chapter, the price of the diet is a matter of moment, and among poorer patients this should be given constant consideration. Variety of foodstuffs is also an essential factor in any diet.

For simplicity in prescribing the Lawrence Line Ration System (44) is hard to improve upon. It was used with success in Professor Monro's wards in the Western Infirmary before the establishment of the clinic and at the clinic of the Royal Hospital for Sick Children, Glasgow (41).

Unfortunately all physicians at the Western Infirmary did not use this system. A uniform diet sheet which would be applicable to all had therefore to be drawn up and the one prepared by the hospital dietitian is shown on page 36. This diet table was very successful, but one had always the able assistance of a dietitian to calculate the quantities of food and fill in the table when prescribing a diet. Without this assistance the table would have presented some difficulties. Variety in the choice of foodstuffs was ensured by giving the patient a series of exchange tables, two samples of which are set forth on page 37. I should strongly advise anyone embarking on the organisation of a diabetic clinic to adopt Lawrence's system of

D I E T T A B L E

ALL FOOD MUST BE ACCURATELY WEIGHED

Breakfast	Oz.	Tea	Oz.
Porridge		Vegetables	
Wholemeal Bread ...		Wholemeal Bread...	
Butter, from Ration		Butter, from Ration	
Eggs		Eggs	
Bacon...		Cheese	
Milk, from Ration		Milk, from Ration	
Tea or Coffee...		Tea or Coffee ...	

Dinner	Supper
Bovril or Oxo	Vegetables... ...
or Clear Soup	Wholemeal Bread
Lean Meat... ...	Butter, from Ration
Vegetables.. ...	Fish ... ...
Fruit...	Eggs ... ...
	Milk, from Ration
	Bovril or Oxo or Tea

Rations per Day

Milk Butter

3% Vegetables

Cabbage
Lettuce
Leeks
Celery
Cauliflower
Tomato
Rhubarb
Brussel Sprouts

6% Vegetables

Carrot
Turnip
Onion
Beetroot

7.5% Fruits

Watermelon
Grapefruit
Lemon

10% Fruits

Orange
Cranberries
Blackberries
Gooseberries

15% Fruits

Apple
Pear

D I E T T A B L E

In place of 1 Egg one of the following may be taken, making the necessary alteration in the daily butter allowance:-

	Oz.	Butter Add Oz.	Butter Omit Oz.
Bacon	1 ...		good ¼
Tinned Tongue	1 ...		No change
Cold Lean Ham	1 ...		No change
Sardines	1 ...		No change
White Fish	1 ...	¼	
Cheese	¾ ...		No change

D I E T T A B L E

In place of 2 oz. White Fish, one of the following may be taken, making the necessary alteration in the daily butter allowance:-

	Oz.	Omit Butter Oz.
Bacon	2	1
Tinned Tongue	2	½
Cold Lean Ham	2	½
Sardines	2	½
Salmon	2	¼
Fresh Herring	2	small ¼

dieting. Excellent recipes for sweet dishes for diabetics are included in The Diabetic Life (44) and in his book for patients and nurses, The Diabetic A.B.C. (45).

Patients were instructed by the dietitian or a member of the nursing staff in the preparation and measurement of the diet. Advice was given on the choice of foods to suit the purse and the season. All patients were encouraged to ask questions and make known their difficulties. It was possible in this way to clear up most of these. Some patients required redistribution of food because they worked on odd shifts, while others had to have the diet altered on account of carried meals. When there was glycosuria without apparent cause the dietitian went over the diet in detail with the patient, and not infrequently this demonstrated some breach of treatment. Where this examination fails to reveal delinquency in a suspicious case, it is sometimes helpful if the medical officer conducts a cross-examination; the patient then frequently admits his transgression.

What has to be done with the patient who habitually departs from his diet? The first thing should be to review the diet and make sure that it is adequate and not too expensive. Many dietary transgressions are as much the fault of the physician as of the patient. I

can recall cases, treated on low carbohydrate diets, and eventually completely abandoned by their physicians on account of dietary delinquency, who on being given a reasonable carbohydrate intake became quite good patients. Some people require coaxing, exhortation or even scolding to prevent departures from diet. Visitation by a home visitor has been shown to be very beneficial (41) (46), but there was no home visiting service operating from the Western Infirmary clinic, and the want was much felt. On no account must a patient be abandoned because of his dietary indiscretions. To do this is to admit defeat and there is no place for defeatism in the fight against diabetes.

It was conclusively proved at the Western Infirmary that, with co-operative patients of average intelligence, dietetic treatment of diabetes could be easily taught to and mastered by outpatients.

V

The Control of Insulin Treatment from the Clinic

There is no need to admit a patient to hospital if insulin has to be started, but one must go slowly when increasing the dose. The first object should be to teach the patient to give his own insulin. Many patients state that they cannot do this, but a little

persuasion and firmness combined with competent instruction should overcome any difficulty in most cases.

Where a patient was referred to the clinic by his private doctor I wrote him giving details of the insulin dosage and requested that he get the district nurse to supervise the treatment and instruct the patient. If the patient was poor and could not afford a private doctor, a letter was sent to the Lady Superintendent of the District Nursing Association making a similar request. The co-operation received from this body contributed materially to the success of insulin treatment with outpatients. The value of co-operation with this Association has also been stressed by Himsworth (47).

Insulin therapy controlled from the clinic proved highly successful. There were very few instances of delinquency on the part of the patient and remarkably few experienced hypoglycaemic symptoms. The majority of insulin cases had two injections per day, though a considerable number required three injections.

When difficulty in controlling glycosuria was encountered specimens of urine passed at various times of the day were brought to the clinic for examination. Special specimen bottles with the times marked thereon were supplied for this purpose. The more intelligent patients tested the urine themselves and brought a

chart showing the result. In this way it was possible to keep the urine sugar free in practically every case where reasonable co-operation was forthcoming. Where glycosuria could not be controlled by urine tests alone, blood sugar estimations were made, but these were seldom required.

Persuasion, explanation of the action of insulin and the demonstration of its beneficial effects on other patients usually overcame the reluctance which many patients have to starting its use. The fewer injections required with the newer insulins will mitigate to some extent the fear which patients used to have of this form of treatment.

Patients were instructed in the symptoms of hypoglycaemia and the advisability of carrying sugar with them, but this point was not overstressed as otherwise sugar was taken when there was really no hypoglycaemia.

On reviewing the results of treatment at the clinic it may be stated that insulin therapy can, in most cases, be successfully controlled from the start at such a centre.

VI

The Recognition and Treatment of Complications at the Clinic

It is very important that complications should be prevented if possible and in any case their early recognition and treatment is of prime importance.

The presence of ketones as demonstrated by the ferric chloride test was taken as the signal for active measures to combat the onset of coma at the Western Infirmary Clinic. On the slightest suspicion of lung trouble X-ray examinations and sputum tests were undertaken to exclude tuberculosis. Patients found to have this disease should have increased diet and insulin and be referred for sanatorium treatment. The importance of this complication in diabetes has been demonstrated by Root (48), (49), (50) and Himsworth (47) advises an annual X-ray examination for all patients. When the tuberculosis is quiescent they can be adequately managed at the clinic, but to prevent further cases I took steps to ensure that such patients were not allowed to wait among the other diabetics.

Any infection was dealt with as soon as discovered and the highest degree of co-operation existed between the hospital surgeons, dental surgeons and the clinic. Special attention was paid to the state of the arteries, and where disease of these vessels was causing gangrene of the foot a surgeon was consulted on the advisability of lumbar ganglionectomy. One outstanding example of this was in a woman aged 64 years. When first seen one leg had been amputated above the knee for gangrene of the foot. A few months later she developed a small

area of gangrene on the remaining foot. She was admitted to hospital and after thorough preparation had lumbar ganglionectomy performed by the late Professor Archibald Young. The circulation in the leg became much better and, after the superficial slough had separated, the lesion in the foot healed completely. All patients with defective circulation were given special exercises for its improvement.

Any patients with eye symptoms, apart from those merely due to rapid changes in sugar concentration at the commencement of treatment, were examined by an occulist so that defects could be dealt with. Among the females there was a considerable number with gynaecological conditions. After treatment at the clinic most of these women were fit to stand operation successfully.

Above all one must have complete co-operation between the clinic and the various specialists. This has been stressed by Joslin (51) whose clinic is one of the best.

VII

The Staff and Routine of the Diabetic Clinic of the Western Infirmary

The staff consisted of a Medical Officer and a Dietitian. Later the dietitian was replaced by a Sister-Dietitian. They were assisted in the work by probationer nurses and student dietitians.

A large dispensary consulting room was used for interviewing the patients. At one side of this room a part was set aside for urine testing and at the other were the weighing machine and filing cabinet. In the centre, placed side by side, were tables for the Sister-Dietitian and the Doctor. There were small male and female examination rooms adjacent to the consulting room.

The following is a resume of a routine session of the clinic. Each patient brought a 24-hour specimen of urine in a bottle bearing his name. These were collected by a probationer nurse and tested. The test-tubes were suitably marked and left in a rack so that they could if necessary be inspected by the medical officer. While this was in progress new patients were examined in the examination rooms, their charts were made out and they were given appointments for blood sugar estimations as indicated above.

Meanwhile old patients were brought in and weighed. They were then interviewed by the sister-dietitian, who marked in the weight and urinary findings. She answered any dietetic queries, and if there was no need for medical advice, allowed the patient to go after settling the date of the next visit. Patients whose conditions were not perfectly controlled were all seen by the medical officer, and in any case no patient was allowed to go longer than

two or three months without being seen, even though his condition were satisfactory.

When alterations in the diet or new diets were required one of the student dietitians made the necessary calculations and these were checked by the sister-dietitian. Investigation of suspected departures from diet were usually undertaken by one of the students in the first instance.

Patients were given personal instruction in the treatment of their disease, and those who were capable of doing so were instructed in urine testing. Some actually gave much assistance to the nurse engaged on this work. Mosenthal (10) does not advocate daily examination of urine by the patient. He states this is the physician's responsibility, but I am not in agreement with him, as a diabetic who is able to test his own urine and adjust his diet if necessary can go much further afield than one who is wholly dependent on his doctor.

In view of the number of patients giving a family history of the disease and the views expressed by certain workers, (24) (52) (53) (54) (55) (56) and (57), on the hereditary nature of diabetes, patients were encouraged to bring any relatives with suspicious symptoms for examination. By this means it was discovered that the two daughters of one patient were also diabetic though their condition had not been previously detected.

Joslin (51) states that we should hunt for the symptomless diabetic as he has the best prognosis.

As the clinic was held in the afternoon many patients could not attend on account of their work, but in some cases a relative brought up a specimen of urine and reported on his condition. In such instances arrangements for seeing the patient at suitable times were periodically made. An evening clinic would be of great advantage for this purpose, but this would, of course, raise the cost. Evening clinics have been advocated by Lawrence and Madders (29).

Patients found to have non-diabetic glycosuria were asked to attend at three monthly intervals for observation purposes. These patients were not put on a restricted diet, but they were advised to observe moderation in eating and drinking. Those with suspected diabetes were naturally also kept under close observation. No marked reduction of their carbohydrate intake was made. Tyner (58), who carried out investigations on obese subjects, maintains that the carbohydrate should be reduced, but the work of Himsworth (21) (22) and (23) suggests rather that in such cases the fat should be reduced in other words they should be given obesity diets.

Conditions other than diabetes were also treated at the clinic. Many of these patients suffered from obesity.

They were not separated from the diabetics as is done in some clinics. It was found advantageous to have a variety of diseases at the clinic as this prevented the work becoming monotonous to the staff.

Where patients were poor and unable to afford adequate treatment steps were taken through voluntary bodies and the public assistance department to give them the necessary help. In a voluntary institution, however, it was not possible to afford them the aid in this direction which could have been given in a centre controlled by a local public health authority.

There was an excellent team spirit among the staff of the clinic, all of whom were very enthusiastic and frequently as many as fifty patients were seen at a single session. I was able to conduct research work on diabetes and this is given in later chapters.

From what has been stated in this chapter it is clear that the diabetic clinic can be utilised as a centre for the treatment and welfare of diabetics.

CHAPTER V

The Diabetic Clinic as part of the Public Health Service

It has been shown in previous chapters that the number of diabetics in the community is increasing, that for the supervision of the poorer patients the clinic forms a very suitable centre and that it can, by early out-door treatment, conserve hospital accommodation for more urgent cases.

At present there are few clinics provided by local authorities, most being attached to voluntary hospitals. Such institutions have not the necessary funds to supply insulin and assistance in obtaining a proper diet to needy patients and application for these has to be made to the local authority. General hospitals moreover do not have an efficient system of home visitation.

What remedy is there for these imperfections in the treatment of diabetes mellitus? The local public health authoritie's already possess the necessary machinery for the operation of a diabetic service, and there is no reason why the onus of maintaining such a service should not be placed on these bodies. Where a council is fortunate enough to have in its area an efficient diabetic clinic run on a voluntary basis a rival one should not be organised, but the managers

of the clinic should be approached with a view to establishing an adequate joint diabetic service for the area.

If no special provision for diabetic treatment has been made in their area the authority should consider establishing the appropriate facilities or requesting the co-operation of a voluntary institution in the formation of such a service. Where a general hospital is maintained by the council it could with advantage be used as the centre for the clinic, but failing this a child welfare or school clinic would meet the need. The utilisation of such premises removes the need for capital expenditure on buildings. If a laboratory is already in existence the cost of equipping it for blood sugar analysis would be small, and where there was no laboratory a test-room could be suitably furnished for Maclean's method of analysis at a cost of about £10. The apparatus required for the Folin Wu method of analysis would be more expensive in view of the fact that a colorimeter and a centrifuge are required.

The running costs of a service would be due mainly to wages and help afforded to patients. No account is being taken of the cost of upkeep of buildings etc. as it is assumed that these premises are already in use and though a portion of the outlay would be chargeable to the diabetic clinic, it would not materially alter

the charge to the public health department as a whole. Assistance in procuring insulin and diet is already given through the public health and public assistance departments, and though it could with advantage be controlled through the clinic, it would not represent an additional burden to the ratepayer.

The Western Infirmary, being a voluntary hospital with an unpaid visiting staff, was in a position to operate a clinic at a minimum cost, and the charges are set out below:

(1)	Medical Officer - a dispensary physician with honorarium of £25 per annum. $\frac{1}{3}$ of dispensary hours in clinic	£8.	6. 8.
(2)	Sister Dietitian - salary £120 and emoluments £100. $\frac{1}{4}$ of time charged to clinic (59).	55.	0. 0.
(3)	Probationer Nurse - salary £35 and emoluments £60. (59) $\frac{1}{12}$ of time at clinic	7.	11. 0.
(4)	Student Dietitians unpaid.		
	Total cost for year ...	£ 70.	17. 8.

There was little extra cost on account of biochemical examinations.

During the year 1935 there were treated at the Western Infirmary Clinic without admission to hospital seventy-eight new cases of diabetes. Prior to the opening of the clinic the majority of these would have

been admitted to the wards for investigation and treatment at a cost of 9/9 per patient per day (59) for periods varying from two to six weeks. If an average duration of three weeks residence is taken that number of patients would have cost the infirmary £798. 10. 6., and as shown above, 35 per cent of them would probably have required the diet and insulin rebalanced afterwards. The clinic might thus be regarded as the most economic means of treating diabetes.

It would not be possible for a local authority to maintain a diabetic clinic at the low costs obtaining in the Western Infirmary. The medical officer, dietitian, nurses and laboratory assistant would all have to be paid, but the cost would not be formidable, and a home visiting service operated by the school nurses and health visitors could be economically arranged.

The medical officer might be an assistant medical officer of health, a specialist or a local practitioner who took a special interest in diabetes. A dietitian, while of great assistance at the clinic, is not indispensible provided a simple system of dieting is employed. Himsworth (47) however advocates the employment of a dietitian and a chiropodist. The nurses can be drawn from the public health nursing service, the members of which are well qualified and could, with a little special

instruction from the clinic medical officer, make quite efficient diabetic nurses for the clinic and for the visitation of diabetics in their own areas. Joslin (46) maintains that it costs no more to keep a diabetic travelling nurse for a year than endow a diabetic bed for a similar period. Blood sugar examinations could be made by the public health laboratory technician or one of the nurses who had been suitably trained.

The cost in respect of salaries of the above service with, say, 48 sessions of the clinic per annum would be:

(1) Medical Officer (B.M.A. Specialist Rate per session)	£126.	0.	0.
(2) One Health Visitor - Salary £300 for ½ day each week	27.	5.	6.
(3) One School Nurse - Salary £260 for ½ day each week	23.	12.	9.
(4) Technician's or Nurse's time on blood sugar examinations...	23.	12.	9.
(5) Home Visitation Estimated as one nurse for one day each week	50.	0.	0.
Total Cost	£ 250.	11.	0.

The total cost would be reduced to £200 if a general practitioner were employed, and to £190 if the clinic were in charge of an assistant medical officer of health. Allowing 50% on the maximum estimate to cover administrative charges and leave a margin for

error the scheme would cost £375 per annum and would be capable of serving a borough with a population between 100,000 and 200,000. In such an area this sum would represent about 0.1 of a penny for general rate purposes. For smaller authorities a clinic meeting once a fortnight would be sufficient.

The administration of insulin to those patients who are incapable of doing this job for themselves will always cause a certain amount of difficulty. The District Nursing Association has always been ready to co-operate in this matter, and local authorities would do well to make an annual grant to this body in respect of such work. Care must be taken to ensure that each patient has his insulin at the correct time.

A public health diabetic clinic by home visitation, and close co-operation between practitioners, other public health clinics and the hospital can adequately supervise the treatment of the diabetic subject and so provide an efficient diabetic service.

PART II

CHAPTER VI

The Ammonia Coefficient of the Urine in Treated Cases of Diabetes Mellitus - The Effect of diet.

(The substance of this chapter was published in the "Glasgow Medical Journal" (1936) vol. 126, p. 323)

The advent of insulin has appreciably increased the span of life for the diabetic subject, but there is still a high death-rate from the disease for which many factors may be responsible. Proper management of these patients certainly presents many difficulties, and even under optimum conditions restoration of normal metabolism is practically impossible. Treatment demands intelligent co-operation on the part of the patient which is not always forthcoming and, indeed, experience in the supervision of a large number of cases at a diabetic clinic shows that many lapses occur. Perhaps the most frequent are deviations from the prescribed diet. It is almost certain that such defects in treatment give rise to slight errors in metabolism which when persisting for extended periods may predispose to complications. Even while the disease is apparently under control there may be a tendency to acidosis. The possibility of some slight disturbance in acid-base equilibrium occurring during the course of treatment appeared worthy of investigation, and it was decided to ascertain

whether in a considerable proportion of cases the ammonia coefficient of the urine was at times abnormally high. A survey of the literature since 1921 failed to reveal any reference to work on this particular aspect of the subject.

METHOD

The present investigation was made principally on out-patients attending the Dietetic Clinic at the Western Infirmary, Glasgow. Subjects selected for examination included those where the disease could be controlled by diet alone and others who required insulin in addition. They were instructed to carry out their usual treatment and to report at the hospital shortly after breakfast, when a freshly passed specimen of urine was obtained for examination and particularly for the determination of the ammonia coefficient (A.C.)

$$\text{A.C.} = \frac{\text{Ammonia Nitrogen}}{\text{Ammonia Nitrogen + Urea Nitrogen}} \times 100$$

In normal healthy individuals not on special diet this value does not exceed 5.0. In diabetics, however, a finding less than 6.0 might be considered satisfactory and this standard has been adopted in assessing results.

RESULTS

The findings in 117 patients examined may conveniently be divided into five groups, these patients were all established diabetics. The results and the diets are set forth in Appendices 1 to 6. Those in Groups 4 and 5 were subjected to repeated investigations at intervals over varying periods.

Group 1 (Appendix 1) consisted of 57 patients who had followed strictly the prescribed treatment and whose condition, from a clinical standpoint, was satisfactory. The subjects were on diets of low or medium carbohydrate content, and some required insulin. The values of the ammonia coefficient varied from 3.7 to 13.8 and were distributed as shown in Table 6:

TABLE 6

A.C.	3 -;	4 -;	5 -;	6 -;	7 -;	8 -;
No. of cases	1	11	11	16	12	4

A.C.	9 -;	10 -;	11 -;	12 -;	13 -;
No. of cases	1	0	0	0	1

Only twenty-three of these values were less than six, and thirty-four of them were six or over. Figure 2a shows in the form of a Histogram the percentage of cases at each class interval. The mean and the median

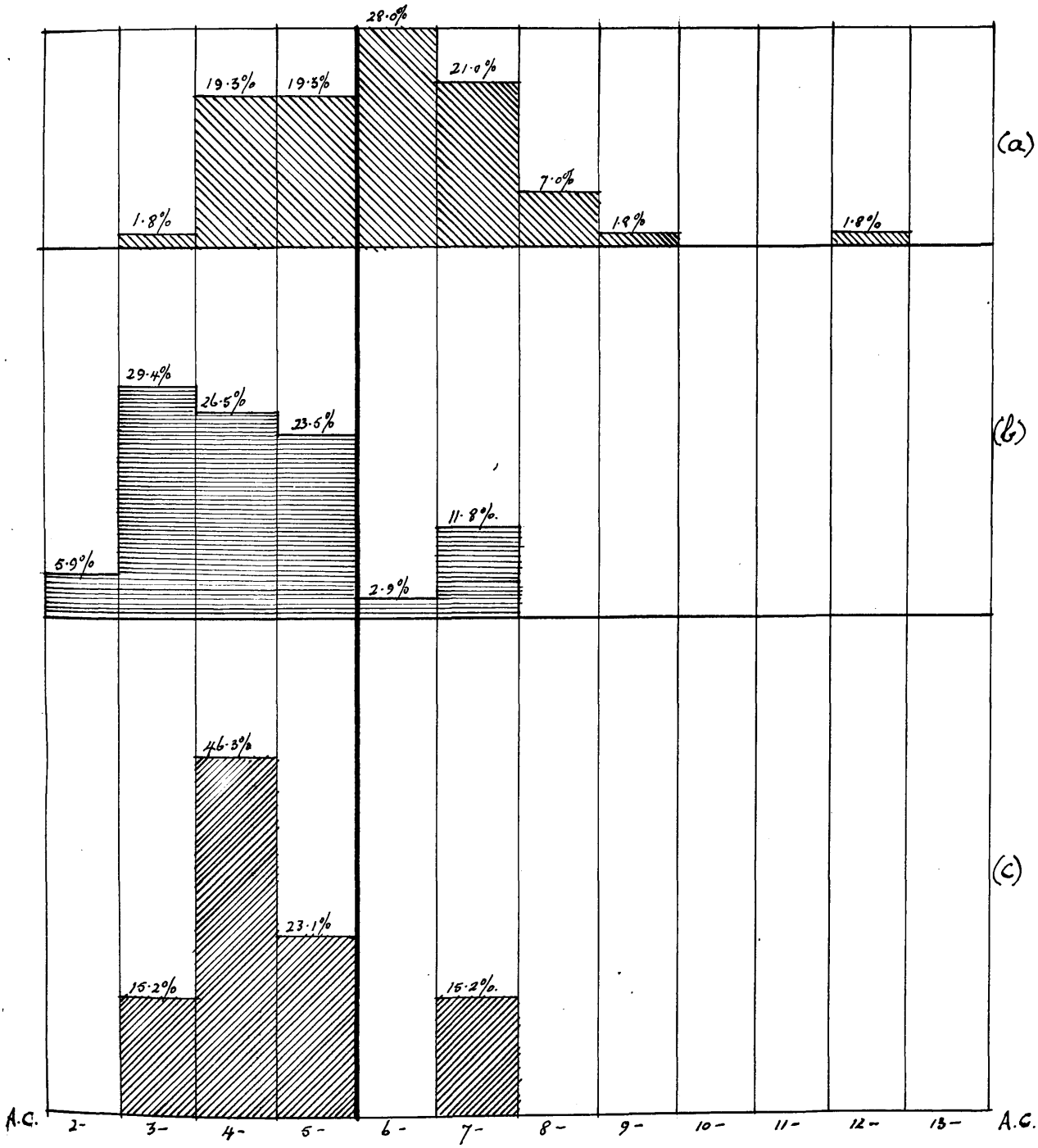


Figure 2

Histogram to show the percentage distribution of the values of the A.C. of subjects in (a) Group 1; (b) Group 2 & (c) Group 3.

value is 6.3, while the Standard Deviation is 1.65; it was thus apparent that by the methods of treatment employed the glycosuria and ketonuria were controlled, but in a number of cases the ammonia coefficient was definitely above normal limits.

Group 2 (Appendix 2) which was used for comparison with Group 1, consisted of 34 diabetic subjects who had completely neglected to follow the treatment prescribed. The values of the ammonia coefficient in this group varied from 2.4 to 7.9 and were distributed as shown in Table 7:

TABLE 7

A.C.	2-;	3 -;	4 -;	5 -;	6 -;	7 -;
No. of cases	2	10	9	8	1	4

The mean was 4.8; the median 4.55 and the Standard Deviation from the mean 1.37. The percentage distribution of the cases in the various class intervals is shewn in Figure 26. Thus, while all these patients had glycosuria and many ketonuria, a much larger proportion than in Group 1 had an ammonia coefficient below 6; this is well shown in the histogram. It is interesting to note that Hubbard and Allen, (60) found the urine of treated diabetics to be more acid than the urine of the untreated. Unfortunately they did not state

the diets employed in their investigations.

The patients were questioned with regard to their departure from treatment. Very few to whom insulin was prescribed had discontinued its use, but practically all had deviated from the prescribed diet. Excess of carbohydrate (C) and omission of protein (P) and fat (F) were the most frequent transgressions. These delinquencies were largely due to carelessness or indifference on the part of the patient, but not infrequently financial inability to procure the diet was a cause. It seemed reasonable to assume that since the proportion of carbohydrate to fat had been considerably raised in this group there might be less tendency to acidosis and possibly a lower ammonia coefficient.

The 13 diabetic subjects in Group 3 (Appendix 3) were examined in order to test the validity of this assumption. These patients were given diets rich in carbohydrates, poor in fat and containing 65 to 75 gms. protein per day. At first the proportion employed was C.150 gms.; P.70 gms. and F.50 gms. Glycosuria and ketonuria were adequately controlled on this diet. The values of the ammonia coefficient varied from 3.5 to 7.5 as shown in Table 8:

TABLE 8

A.C.	3 -;	4 -;	5 -;	6 -;	7 -;
No. of cases	2	6	3	0	2

and are set forth in the form of a percentage histogram in Figure 2c.

The mean was 5.0, the median 4.9 and the Standard Deviation from the mean, 1.15. Although the number of cases is not large the results would appear to support the view that on a diet rich in carbohydrate and poor in fat the ammonia coefficient may be kept nearly within normal limits.

In Group 4, consisting of 9 patients, examinations were made to ascertain whether a reduction of the ammonia coefficient could be effected solely by raising the carbohydrate and lowering the fat intake. The first 4 subjects (Appendix 4) had been on a fairly high fat intake for a considerable period, and the effect of increasing the proportion of carbohydrate to fat was, in each case, to reduce the value of the ammonia coefficient.

The remaining 5 patients (Appendix 5) who had not received previous treatment, were put on a diet of 8 to 10 (old) Lawrence Line Rations (44) (C. 5 gms., P. 7.5 gms., F. 15 gms. per line). After repeated exam-

inations of the urine had been made, a diet consisting of C. 150 gms., P. 70 gms. and F. 50 gms. was substituted and was, in most cases, raised as shown in the Appendix. The ammonia coefficient was estimated while on these diets and was found, on the average, to be lower than while on the Lawrence Line diets. In all cases the urine remained sugar free after the change of diet. From these results it is clear that the ammonia coefficient is lowered by raising the carbohydrate and diminishing the fat intake.

High carbohydrate diets generally contain a considerable quantity of fruit, and so the possibility of lowering the ammonia coefficient by the ingestion of base-forming substances (organic acids) had to be considered. The 4 patients in Group 5 (Appendix 6) were examined while on a high carbohydrate, low fat diet containing the minimum quantity of fruit, and subsequently on one of the same food value with a high fruit content. The results seem to indicate that fruit is not more effective than other forms of carbohydrate in lowering the ammonia coefficient, it would, therefore, appear that it is the increase in available glucose or the diminution of fat and not the base derived from the fruit which is the chief

factor in this process.

DISCUSSION

In a considerable proportion of diabetic subjects adhering strictly to accredited methods of treatment the ammonia coefficient is definitely above normal limits, which indicates that ammonia formation is necessary to prevent acidosis. As these patients (Group 1) had given excellent co-operation it could be assumed that any defect lay in the treatment prescribed. The results obtained in the succeeding groups show that the ammonia coefficient can be lowered by adjusting the diet so that the proportion of carbohydrate to fat is increased. This is especially well shown in in Figure 2 where the results in Groups 1, 2 and 3 are shown in the form of histograms. The vertical line divides the values less than 6 from those of 6 and over. It is significant that in Group 2 where extra carbohydrate was taken by the patients, and in Group 3 where the carbohydrate was purposely increased and the fat curtailed, the percentage of subjects with ammonia coefficients of 6 or over was very low.

It is problematical to what extent and in what ways the conditions causing a raised ammonia coefficient may affect adversely the patient's health, but they can evidently be controlled and the value maintained within

normal limits by this dietetic adjustment. Of the twenty-six patients so treated one only (Case 117) gave a persistently high value. Here the administration of alkali had a beneficial effect.

Rabinowitch (61) has been largely responsible for the introduction of the high carbohydrate low fat diets in diabetes. He has shown (62) that whereas on a low carbohydrate high fat intake the blood cholesterol is raised, it is, on the other hand, kept within normal limits on a high carbohydrate low fat consumption. On the latter diet which resembles very closely that of a working-class family, and which is one of the cheapest to procure, the patients remain well. With careful adjustment such a diet does not necessitate an increased consumption of insulin, and it might therefore be used more frequently in treating cases of diabetes mellitus. On account of its low fat content it is eminently suitable for obese patients and those with disease of the biliary system.

CHAPTER VII

The Relationship of Cost of Diet to Dietary Delinquency

In view of the fact that many instances of dietary delinquency in diabetes consisted of the replacement of expensive foods by carbohydrate, the part played by the greater cost of diabetic compared with normal diet in the production of dietetic indiscretions seemed worthy of investigation. If the amount of delinquency increased with a rise in cost of the diet, then the expense of diabetic diet could be regarded as a possible cause of failure in treatment. The patients attending the Western Infirmary Clinic were by no means well off, and therefore formed a suitable group for an investigation such as the present. Those with large incomes would not be suitable as the purchase and use of food would be dictated rather by the palate than the purse.

METHOD

The prescribed diets of 393 diabetic subjects - 141 males and 252 females - attending the diabetic clinic were priced according to the January Price List of a large Glasgow store with the assistance of the dietitian. No allowance was made for the cost of preparing the food. Patients on diets with unweighed protein and fat were not included in the investigation.

The subsequent behaviour of these patients with regard to dietary delinquency was observed.

RESULTS

The results are set forth in Table 9 which gives for males, females and persons the number of patients on diets of various prices and the number and percentage of those who departed from them. Figure 3 gives the percentage findings in the form of a graph. The results in males, when smoothed by the method of moving averages, gives the curve C, while those for females when similarly treated result in curve E.

Consideration of the findings relating to persons shows that there is less delinquency when the cost of the diet is low than there is when it is high.

In the case of females 31% of the total departed from diet and it is evident that as the price of the diet increases so does the percentage of patients who depart from it. Diets costing between 8/- and 10/- per week belong mainly to the high carbohydrate and moderate or low fat type, and it is in these price groups that dietary delinquency is at a minimum. The slight increase in dietetic

TABLE 9

Price of Diet per week	MALE			FEMALE			PERSONS		
	Total	Number of Delinquents	Percentage of Delinquency	Total	Number of Delinquents	Percentage of Delinquency	Total	Number of Delinquents	Percentage of delinquency
7/- -	3	1	34	18	4	22	21	5	24
8/- -	25	8	32	75	14	19	100	22	22
9/- -	16	3	19	12	2	17	28	5	18
10/- -	18	5	28	49	19	39	67	24	36
11/- -	27	9	33	65	23	35	92	32	35
12/- -	32	8	25	28	11	39	60	19	32
13/- -	9	1	11	2	2	100	11	3	27
14/- and over	11	3	27	3	3	100	14	6	43

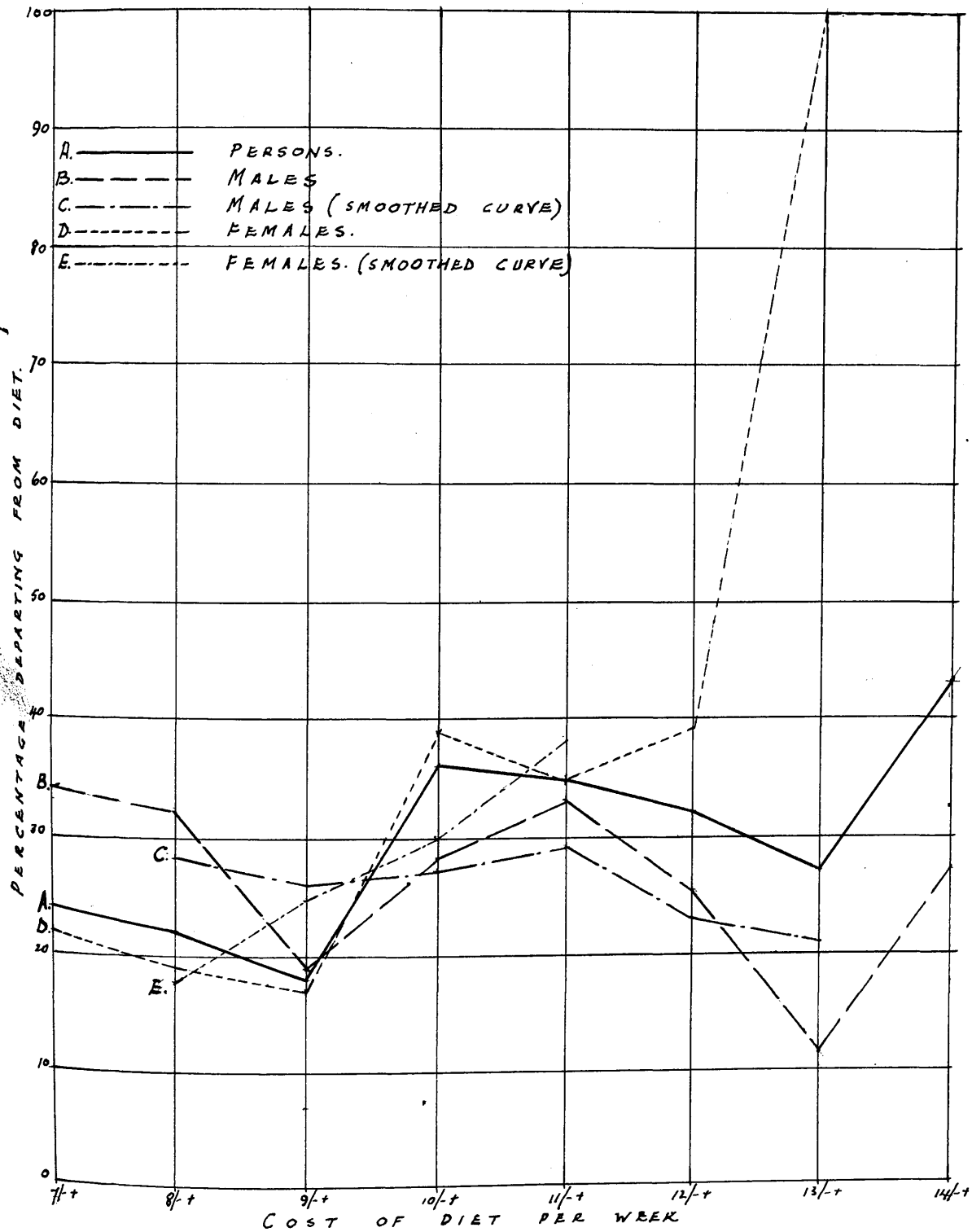


Figure 3

Graph showing percentage delinquency with diets of various prices.

indiscretions when the cost is less than 8/- may be due to these diets being too restricted. With diets of 12/- and over the number of patients is so small that no comclusion can be drawn from the fact that all departed from treatment.

27% of males failed to keep to the prescribed diet. Dietary delinquency did not rise with increased cost of diet and curve C, Fig. 3 actually shows that there is a slight trend towards reduction of "diet-breaking" with the more expensive diets.

DISCUSSION

The fact that price does not influence adversely the adherence to diet among males may be due to several factors. Greater expenditure of energy may create a desire for the fatty foods even though they are expensive, and a man does not usually have to cook his own food. Not infrequently this is prepared and measured by his wife or other member of the household and pains are taken to ensure that the correct diet is presented and adhered to.

With women, on the other hand, there is constant temptation in the kitchen to take some extra carbohydrate. Moreover, the housewife has to buy the food, and when short of money she may neglect her own diet rather than

adhere to it at the expense of the family. Many female patients frankly admitted at the clinic that they had had extra carbohydrate because they had not the wherewithal to buy the protein and fat included in the prescribed diet. Lapp (63) stresses the need for a diet which the patient can afford but he does not produce any evidence to show that price per se may be a cause of dietary delinquency.

CONCLUSION

The cost of diet obviously plays a part in determining the strictness with which a patient adheres to treatment. This is especially noticed in females, and in planning the treatment of working class patients the question of expense must always be kept in mind.

CHAPTER VIII

The Relationship of the Calorific Value of the Diet to Dietary Delinquency.

In the Allen era patients were treated by under-nutrition diets. Restriction in the amount of food was less severe after the introduction of insulin, but even now diabetics are given diets lower in calorific value than the normal. An insufficient supply of energy giving foods might induce a patient to break from treatment, and in order to find out if this were the case the following investigation was undertaken.

METHOD

The calorific content of the diets of 379 diabetic subjects - 133 males and 246 females - attending the clinic was noted and the subsequent history of each with special reference to adherence to diet was investigated.

RESULTS

In table 10 is set forth the numbers of males, females and persons on diets of varying energy value. The number of those who departed from treatment and the percentage of delinquency in each group is also shown. Figure 4 gives a graphic representation of these results.

TABLE 10

Calorie Value of Diet.	MALES			FEMALES			PERSONS		
	Total No.	No. of Delinquents	Percentage Delinquency	Total No.	No. of Delinquents	Percentage Delinquency	Total No.	No. of Delinquents	Percentage Delinquency
- 1299	3	0	0	18	5	28	21	5	24
- 1499	28	7	25	84	16	19	112	23	21
- 1699	26	7	27	52	15	29	78	22	28
- 1899	27	9	34	57	24	42	84	33	39
- 2099	20	6	30	27	9	34	47	15	32
2100 -	29	6	21	8	6	75	37	12	32

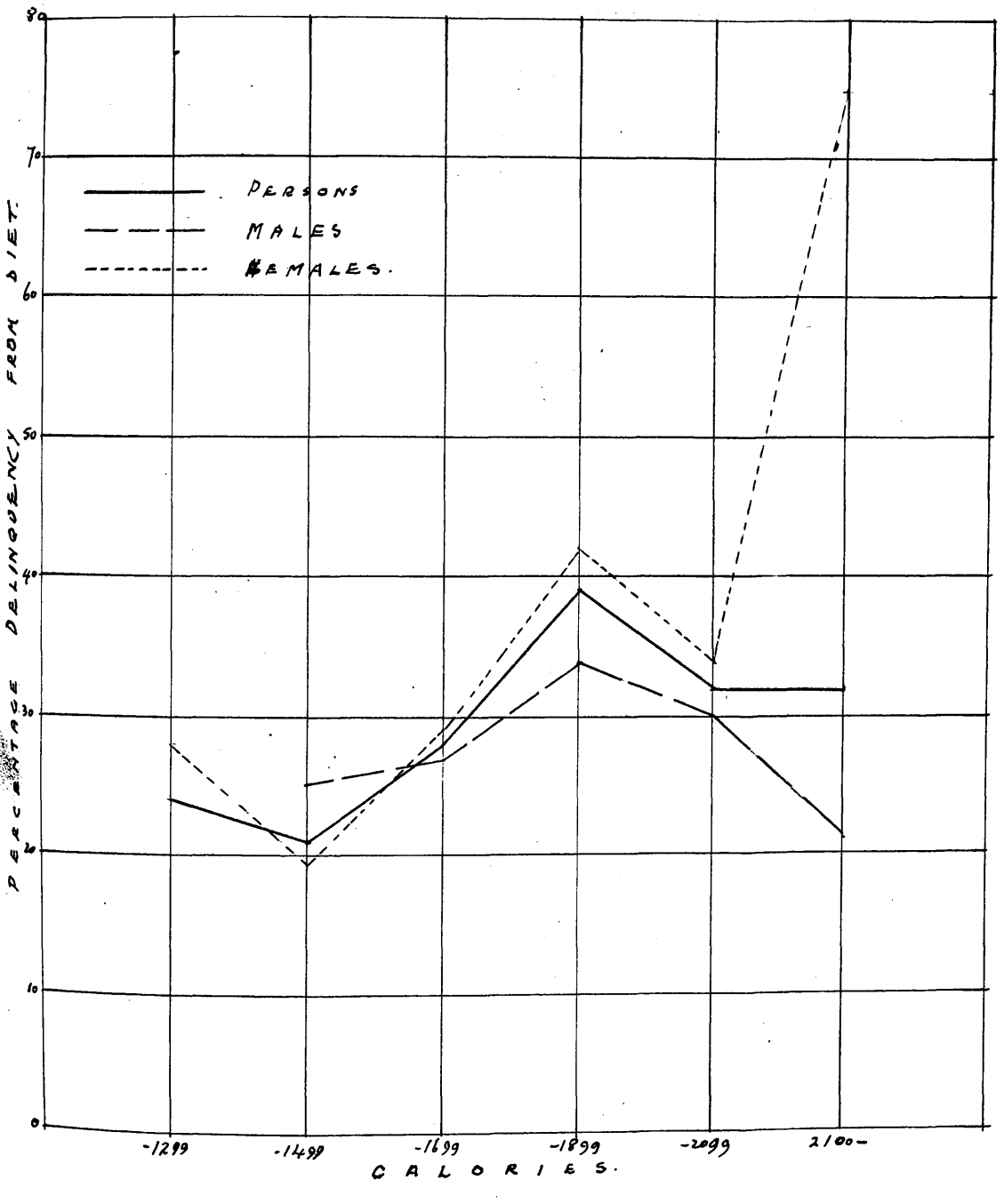


Figure 4

Graph showing percentage of dietary delinquency of patients on diets of various calorific value.

The findings for persons indicate that departures from treatment are more frequent with high calorie diets, but as the majority of patients were females and the reaction to dieting differs in the sexes, this generalisation is misleading.

In women there is a very definite increase in delinquency as the calorific value of the diet rises above 1500 calories. The curve for females in Figure 4 corresponds very closely to the one in Figure 3 which refers to delinquency relative to the cost of diet.

Very few men receive diets of less than 1299 calories, and such cases can therefore be left out of consideration. Delinquency appears to increase with rise in the calorific intake until diets of 1900 calories are reached, after which there is a decrease in departure from treatment.

DISCUSSION

High calorie are more expensive than low calorie diets on account of the larger amount of fat which they contain. It may therefore be the increase in cost which accounts for the departure from treatment of a considerable number of women on such diets. The large amount of fat in them may not appeal to

some patients, especially those who lead relatively sedentary lives.

Among men the decrease in "diet-breaking" with increase in calorific intake above 1900 calories suggests that some departures from diet may be caused by allowing the patient insufficient food for his energy requirements. It is difficult to account for the decreased delinquency with the diets of low calorific value, but here reduced cost may play a part.

CONCLUSIONS

It would appear essential in planning diets, especially in male subjects, to allow a sufficient number of calories as well as to supply a reasonably priced diet. Many workers in the past gave very low diets, but one must remember that diabetics are only human and that the pangs of hunger will readily overcome the better judgment of the average patient. It has been my experience that a little extra food allowed judiciously will do infinitely less harm to the diabetic than that which he takes surreptitiously.

CHAPTER IX

CONCLUSION

It has been shown that the number of diabetics in our midst is increasing and that the family practitioner cannot, without outside help, maintain these valuable members of the state in good health. A diabetic clinic such as the one at the Western Infirmary of Glasgow goes far to supply the necessary assistance to the family doctors in the treatment of this disease, but it cannot fulfill this need completely.

A Public Health Diabetic Service in co-operation with local hospitals and practitioners appears to be a very suitable means of securing the very best supervision and treatment for the working class diabetic. In such a service the patient should be taught to control his disease by diet and insulin. The diet prescribed should be adequate, as near as possible to the normal, and should not be expensive.

Finally it should be emphasised that the diabetic is generally a relatively intelligent person who has a genuine wish to earn his own living, and it seems only reasonable that he should receive all the help which the community can afford him.

APPENDIX 1A

CASE NO.	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
1	M	58	148	83	68	1536	40	8.6	An uncomplicated case. Had had indoor treatment before being referred to clinic.
2	M	35	100	90	170	2290	42	4.1	Had been a diabetic for three or four years, had carried out his treatment as directed and had no complications of note. He had been in hospital twice for regulation of the diet.
3	M	25	109	100	100	1736	60	4.8	He had suffered from diabetes for 7 years and had been admitted to hospital on three occasions, once in coma.
4	M	24	146	136	110	2118	25	4.6	This man had had symptoms for a few months and had been in hospital for regulation of diet and insulin.

CASE NO.	SEX	AGE	DIET. C	P	F	CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
5	F	32	110	68	135	2027	75	13.8	A married woman who, a year before, had been admitted to hospital with severe diabetes. She had not followed instructions regarding diet and insulin and had been brought back to hospital in coma. She made an uneventful recovery and the ammonia coefficient of the urine was estimated just prior to her leaving hospital.
6	F	54	120	80	150	2150	None	5.0	A married woman. She had suffered from diabetes for a year. Neuritic pains in the arms had been a troublesome feature but these had been relieved at the time of the investigation. This woman died a year later from rupture of a basilar aneurism.

Appendix 1A

CASE NO.	SEX	AGE	DIET. C	P	F	CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
7	M	66	120	90	180	2460	None	5.1	This man had suffered from mild diabetes for 18 months. Distance prevented his visiting the clinic regularly. Two years later he developed gangrene of leg, which had to be amputated, and later coronary thrombosis from which he died.
8	F	68	48	64	128	1600	None	4.3	An elderly married woman with mild senile diabetes. She could not attend the clinic regularly on account of distance. She had been in hospital a year before and had been discharged on the above diet, to which she adhered.
9	M	53	111	82	142	2046	None	7.0	Was found to have diabetes when admitted to hospital with septic condition of hand a year before. He made a good recovery and remained well on the above diet. He subsequently required to take insulin.

CASE NO.	SEX	AGE	DIET. C	P	F	CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
10	F	63	80	60	120	1640	None	6.0	Married woman. Diabetes of 3½ years standing. Had been in hospital twice for adjustment of diet.
11	M	64	80	60	120	1640	None	6.5	This patient had suffered from rheumatic heart disease and diabetes for a number of years. He had been in hospital for treatment. He subsequently died from the heart condition.
12	M	13	110	82	165	2253	None	5.4	This lad had diabetes of 9 months duration. He had had treatment in hospital but had not suffered from any complication.
13	F	57	80	60	120	1640	None	4.1	Had diabetes of 4 or 5 months duration. She had not been in hospital but had responded to treatment as an out-patient.
14	F	55	100	75	150	2050	None	3.7	Married woman. Duration of disease 6 months. Responded to treatment as out-patient.

CASE NO.	SEX	AGE	DIET. C	DIET. P	DIET. F	DIET. CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
15	F	51	90	67	135	1843	65	8.7	Married woman. Diabetes of eleven years duration. She had been in hospital several times. She had not had any severe complication.
16	F	49	90	67	135	1843	None	4.6	Married woman. Diabetes found when she was admitted to hospital for a gynaecological operation six months before. She responded well to treatment.
17	F	47	100	75	100	1600	15	7.6	Diabetes discovered when admitted to hospital with septic condition. Responded well to treatment.
18	F	50	100	+	+		10	4.2	Married woman. Diabetes discovered when she was admitted to hospital for operation for prolapse of uterus. She had operation after diabetes was under control.
19	F	19	98	68	120	1744	30	5.1	This girl had diabetes of very acute onset four months previously. She responded well to diet and insulin. She subsequently died after a streptococcal infection of throat.

CASE NO.	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
20	F	65	100	65	100	1560	None	6.0	Married woman with symptoms of 4-6 months duration. Disease controlled by dieting without indoor treatment.
21	F	59	80	+	+		None	5.2	Married woman. Had been admitted to hospital 3 months previously with diabetes of gradual onset. No complications.
22	M	59	100	+	+		20	5.3	Had been discharged from hospital after treatment for diabetes three months previously. He was a worker in Imperial Chemical Industries Ltd. and had suffered from T.N.T. poisoning during the 1914-18 war.
23	F	25	100	75	150	2050	5	7.4	Married woman. She was very thin. Had had diabetes for about six months and had received hospital treatment. She had had no complications.
24	M	60	120	+	+		20	5.1	Suffered from diabetes of recent onset for which he had received treatment in the wards.

CASE NO.	SEX	AGE	DIET. C	DIET. P	DIET. F	DIET. CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
25	M	53	110	+	+		30	7.6	A diabetic of several years standing who had previously been in the wards for regulation of his diet.
26	F	67	100	75	150	2050	None	6.6	Married woman. A diabetic of two years standing. First came to this hospital with septic finger 3 months ago. She had treatment in the wards.
27	F	40	100	75	150	2050	45	6.0	Married woman. Duration of disease two years. Had been in wards for adjustment of diet and insulin.
28	M	17	110	75	100	1640	None	5.7	Three months before this lad had noticed the gradual onset of diabetic symptoms. He responded to treatment. Subsequently, after an infection, his tolerance became less and he had to take insulin.
29	M	64	120	+	+		10	6.6	This man came to the clinic 8 months previously with marked diabetes of recent onset. It was not found possible to get the condition completely under control as an out-patient and he had to be admitted to hospital for a few weeks. The above estimation was made after his discharge from hospital.

CASE NO.	SEX	AGE	DIET. C	DIET. P	DIET. F	DIET. CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
30	F	59	90	67	135	1843	None	4.4	Married woman. She had come to clinic 3 months previously having symptoms of diabetes of gradual onset. She required 15 units of insulin per day but had been able to dispense with this at time of observation.
31	F	60	90	67	135	1843	None	6.1	Married woman. Two months before she had been admitted to hospital with a gangrenous patch on the foot. She was found to have diabetes and admitted having had symptoms for some time previously. She made a good recovery.
32	M	51	100	75	150	2050	20	6.3	Diabetes of a few months duration. Had diet balanced as out-patient. Was subsequently rebalanced in hospital on a diet of C120, P. & F. unweighed and 40 units of insulin.
33	F	52	100	75	150	2050	12	7.2	This married woman had suffered from diabetes for several years. She had previously been in the wards and the diet and insulin had been balanced. She subsequently died after a gynaecological operation.

CASE NO.	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
34	M	18	140	+	+		80	5.8	This lad was admitted three months before with diabetes of fairly acute onset. He progressed very well indeed.
35	F	56	90	75	100	1560	None	6.1	This married woman was discovered to have diabetes when she went to Glasgow Eye Infirmary and was found to have diabetic retinitis. The diabetes responded to treatment but the retinitis progressed.
36	M	52	120	90	180	2460	None	6.8	Had been admitted three months before complaining of diabetic symptoms of gradual onset. The disease was adequately controlled on the above diet.
37	F	32	100	75	100	1600	None	8.3	This married woman had, six months previously, been admitted to another hospital for a gynaecological operation, when she was discovered to have diabetes and exophthalmic goitre. Her progress was very satisfactory.

CASE NO	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
38	M	56	150	70	130	2050	20	6.5	Diabetes of over a year's duration. Had been in hospital 9 months previously for dietetic and insulin adjustment.
39	M	17	80	90	1600	2120	75	6.5	This lad had diabetes of two years' duration. He was treated in hospital but the diet did not meet his requirements when back at work and he had to be rebalanced on the above diet, which was apparently successful.
40	M	51	110	82	165	2253	30	7.6	Had been admitted to wards 4 months previously with septic ulcer on foot and was then found to have diabetes. The ulcer healed up and he was allowed home on the above diet and insulin. He had thickened arteries and two years later he developed gangrene and had his left leg amputated.
41	F	32	114	117	98	1806	18	7.5	Married woman. Admitted to wards 4 months previously with diabetes of gradual onset. After discharge she required readjustment of diet and insulin.

CASE NO.	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
42	F	53	100	75	150	2050	None	6.8	Married woman with fairly mild diabetes of at least six months duration. She responded to out-door treatment.
43	M	61	140	+	+	·	None	7.3	Had been admitted six months previously with gangrene of toe. Found to have diabetes. He required insulin in hospital but was later able to omit this.
44	F	61	80	60	120	1640	50	6.6	Married woman with diabetes of $4\frac{1}{2}$ years duration. She had thickened arteries and later suffered from cerebral thrombosis.
45	F	66	90	67	135	1843	10	7.6	Came to clinic four months previously complaining of symptoms of diabetes of gradual onset. Condition was readily controlled on the above diet and insulin.

CASE NO.	SEX	AGE	DIET.				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
46	M	67	90	64	135	1843	None	7.2	Had been admitted to hospital a month beforehand with diabetes of 3 or 4 months' duration. Estimation of A.C. carried out just before discharge.
47	F	60	80	60	120	1640	None	7.2	Married woman. Had been attending clinic for 4 months. During previous two years she had had symptoms of diabetes.
48	F	58	110	100	90	1690	20	5.2	Married woman. 2½ months previously had noticed symptoms of diabetes. She had been in hospital and the condition was controlled on the above diet and insulin.
49	F	51	150	75	100	1800	20	7.1	Married woman. Two months before she had been admitted to the wards with a submaxillary abscess. She was discovered to have diabetes and responded well to appropriate treatment.

CASE NO.	SEX	AGE	DIET. C	DIET. P	DIET. F	DIET. CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
50	F	19	110	100	100	1740	10	4.2	Had recently been admitted to medical wards with marked diabetes of short duration. She was discharged off insulin but had to be given 10 units per day shortly after dismissal. This girl subsequently developed a lung condition radiologically similar to tuberculosis. There was never a positive sputum. The condition subsided on treatment by rest, open air, increased diet C180; P100; F125; Cals.2110 and 55 units insulin.
51	F	64	130	70	100	1800	50	9.2	Married woman. She was admitted to hospital 4 months before on account of a septic toe. It was then that she was found to have diabetes.
52	F	12	80	60	120	1640	60	8.0	Six weeks before this child had been brought to the clinic very acutely ill and had been immediately admitted to hospital, where she made an uneventful recovery. A history of diabetes of many months' duration was given.

CASE NO.	SEX	AGE	DIET. C	DIET. P	DIET. F	DIET. CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
53	F	65	100	75	150	2050	None	6.8	Married woman. Diabetes of 2½ years' duration. She had been in hospital for treatment when she first developed the disease. Apart from some giddiness she was free of symptoms.
54	F	67	80	60	120	1640	None	4.4	Married woman. She was admitted to hospital on account of weakness and pains in chest, possibly of cardiac origin. Discovered to be a diabetic. Later an Electro-cardiogram gave a picture compatible with coronary artery disease.
55	F	54	80	60	120	1640	None	5.9	Married woman. Had diabetes of 7 months' duration. She had symptoms of gall bladder disease and tenderness in epigastrium when she first came under observation. She was treated as an in-patient to begin with, but the A.C. was estimated while she attended the out-patient department.

CASE NO.	SEX	AGE	DIET. C	P	F	CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
56	F	37	116	75	120	1844	33	4.8	This woman was referred from Glasgow Royal Maternity & Women's Hospital after a confinement. The disease had been present for six years. Her brother had died of diabetes.
57	M	24	50	75	150	1850	10	6.8	This man had diabetes of about 4 months' duration. He had no complications and responded well to treatment.

A P P E N D I X 2

The patients referred to in this appendix had all deviated from the prescribed treatment at the time of examination

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
58	M	50	80	60	120	1640	40	3.4	Had received indoor treatment previously but had, since his discharge, been a delinquent both as regards diet and insulin.
59	F	59	45	60	120	1500	30	4.1	This married woman had suffered from diabetes for several years. She had been treated in the wards and discharged on the above diet, to which she had not adhered.
60	M	16	39	52	104	1300	40	3.9	Diabetic of two years standing. Had had treatment in wards and discharged on above diet. He did not keep to the diet.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
61	M	27	100	+	+		30	5.1	Diabetic of four years standing who never kept to his diet. He had been in the wards on several occasions.
62	F	62	54	72	144	1800	20	5.5.	This married woman, a diabetic of about a year's duration, had been treated in wards but departed from the prescribed diet on discharge.
63	F	13	113	102	81.5	1594	25	3.6	This child had had diabetes for two years and had been treated in the wards. The diet was too expensive and she was allowed to depart from it.
64	M	33	100	75	150	2050	30	5.8	The man had been a diabetic for 18 months, had received treatment in the wards, but on discharge had completely departed from the diet.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
65	M	52	60	80	160	2000	None	4.7	A diabetic of two-and-a-half year's duration who had been treated in the wards but neglected to keep to diet after his discharge.
66	M	72	108	90	90	1602	None	4.6	A diabetic of over a year's standing. He had received indoor treatment but had departed from his dietary regimen after discharge.
67	F	50	54	72	144	1800	None	3.2	This married woman had had diabetes for at least two years. She had been in the wards for treatment but appeared to be quite incapable of keeping to the prescribed diet. She developed cataract, which was later treated by operation, and she ultimately did well on a high C, low F diet with insulin.
68	F	39	96	67	135	1843	None	7.9	This married woman had diabetes of a year's duration. She had been in wards for treatment but had departed from diet after discharge.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
69	F	47	160	150	130	2410	None	7.0	This married woman, suffering from diabetes of 3 years' duration, had received indoor treatment but had not adhered to diet after discharge.
70	M	53	110	82	165	2253	15	3.8	This man had suffered from diabetes for one year. He could not be treated adequately as an outpatient on account of his not carrying out treatment correctly. After treatment and instruction in wards he was discharged but failed to adhere to his diet.
71	M	55	60	80	160	2180	10	5.9	This man had diabetes of a year's duration. He was treated as an out-patient but failed to keep to his diet.
72	F	55	57	68	136	1700	45	2.5	This married woman was admitted to hospital with mastoiditis a year previously. She was found to have diabetes and was treated for this disease but failed to follow treat-ment after her discharge.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
73	F	63	90	67	135	1843	None	5.7	A married woman. She came to clinic 5 months previously. She had had diabetes for a considerable time and suffered from cataract. She was balanced on the above diet but failed to adhere to it.
74	F	57	80	60	120	1640	None	2.4	This married woman had diabetes of several months duration. She responded to treatment as an outpatient but subsequently departed from her dietary regimen.
75	F	64	50	75	150	1850	None	4.5	The woman, whose three children were diabetic, was discovered to have diabetes when she was admitted with gangrene of the foot a year previously. She did well in hospital but did not adhere to diet. She subsequently had threatened gangrene of other leg, which was prevented by lumbar ganglionectomy.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
76	F	61	57	75	150	1850	None	3.9	A married woman. Diabetes of a year's duration. Treated as an outpatient but had not adhered to diet.
77	M	56	50	80	165	2005	None	3.3	A stout man with arterial degeneration. The diabetes was of fully six months duration. He was treated as an outpatient but he subsequently failed to observe his dietary restrictions.
78	F	38	100	75	150	2050	35	3.8	Nine months previously this married woman had come to hospital with a whitlow. She received treatment as an outpatient, but though she responded to treatment she subsequently departed from her dietary regimen.
79	M	40	140	70	100	1740	45	6.5	This man had diabetes of over a year's duration and had been treated in the wards, but after discharge neglected treatment.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
80	M	58	100	+	+	+	55	4.8	Was admitted to hospital six months previously suffering from abscess in neck. He was found to have diabetes and was treated with satisfactory result, but did not carry out adequate treatment after discharge.
81	F	36	120	90	180	2460	35	7.1	A married woman who had been brought to hospital for first time in diabetic coma eight months previously. She was discharged well, but failed to adhere to diet. She subsequently did well on a high C, low F diet.
82	F	30	150	75	100	1800	None	5.0	A married woman, she had diabetes of at least six months duration. She was treated as an outpatient but eventually departed from the regimen.
83	F	31	130	75	100	1720	None	4.1	A married woman, had diabetes of almost a year's duration. The condition was controlled as an outpatient, but she did not keep to her diet after she was free of symptoms.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
84	M	54	100	75	100	1600	10	7.8	This man had diabetes of about a year's duration. He had been treated as an outpatient. He did not keep to diet and stopped taking insulin.
85	F	60	100	75	100	1600	None	5.4	A married woman who had recently come to the clinic with symptoms of diabetes of gradual onset. She was balanced on the above diet, but failed to adhere to it.
86	F	63	90	67	100	1528	10	4.1	This married woman came to hospital six months before suffering from haemorrhoids. She was found to have diabetes and received outpatient treatment for this disease before the operation. She failed to keep to her diet after discharge from the wards.
87	F	57	90	67	135	1843	None	4.5	This married woman had diabetes of about a year's duration. She responded to treatment as an outpatient but never kept strictly to her diet.

Appendix 2

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
88	M	52	120	82	165	2292	6	5.8	Six months previously this man had been admitted to the wards with a septic condition of the foot. He was found to have diabetes which was readily controlled by diet and insulin. The septic condition cleared up. After discharge he did not carry out the dietary treatment.
89	F	53	100	+	+		None	4.6	Five months previously this married woman had made her way directly to the clinic complaining of diabetic symptoms of gradual onset. She responded to treatment as an outpatient but subsequently departed from the dietary regimen.
90	F	50	60	80	160	2000	None	3.9	Four months previously this married woman was sent to the clinic on account of diabetes of about two years' duration. She responded to dietetic treatment but eventually did not adhere to the diet.
91	F	56	80	60	120	1640	30	3.8	This married woman had diabetes of recent onset and had had treatment in the wards. After discharge she did not keep to the diet.

A P P E N D I X 3

This group of patients was treated on high carbohydrate, low fat diets in order to determine the effect of these diets on the Ammonia Coefficient of the urine.

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
92	F	63	150	70	50	1330	None	3.5	This married woman was found to be diabetic two years previously when she was under treatment for a skin condition. She was successfully treated as an outpatient.
93	M	84	150	70	50	1330	None	4.6	This man had been referred to the clinic fourteen months previously on account of diabetic symptoms of gradual onset. He responded well to treatment.
94	F	60	180	73	54	1498	24	4.9	This married woman came to the clinic four months previously with diabetic symptoms of gradual onset. Outpatient treatment proved satisfactory.

Appendix 3

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
95	F	42	150	70	50	1330	None	5.5	This married woman had diabetes of about 2 years' duration. She responded to treatment on high C, low F after other diets had failed. She refused to take insulin.
96	F	69	150	70	50	1330	10	4.2	A married woman, she had had diabetes for at least six months. She was treated as an outpatient.
97	M	63	170	70	50	1410	20	7.5	This man was found to have diabetes when, two months previously, he was admitted to the wards with an abscess of neck. The ammonia coefficient was estimated while he attended the clinic after discharge.
98	F	17	150	70	50	1330	36	5.2	This girl had been referred to the clinic seven months before on account of diabetic symptoms of gradual onset. She responded to outpatient treatment.

Appendix 3

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
99	F	58	180	70	50	1450	20	4.5	A married woman, she had come to a surgical dispensary two months previously on account of boils. She was found to have diabetic symptoms of gradual onset and was referred to the diabetic clinic for treatment. She did not require indoor treatment.
100	F	42	150	70	50	1330	None	3.7	Five months beforehand this married woman had come to the clinic on account of diabetic symptoms. She was successfully treated as an outpatient.
101	M	30	150	70	50	1330	None	4.9	This man had diabetes of at least four months' duration. He had come to the hospital on account of boils. He was treated as an outpatient.
102	M	8	150	70	50	1330	10	5.3	This boy was in the wards suffering from diabetes of fairly acute onset. He had been a known diabetic for about three months at the time of the examination.

Appendix 3

CASE NO.	SEX	AGE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
			C	P	F	CALS.			
103	F	65	150	70	50	1330	None	4.5	This married woman, who was treated as an outpatient, had attended two months previously on account of pronounced symptoms of gradual onset.
104	F	73	150	70	50	1330	12	7.3	This married woman had had diabetes for some time. She had attended the clinic for two months. She had marked arterio-sclerosis.

APPENDIX 4

These patients had the Ammonia Coefficient of the urine estimated while on different types of diet. The diet and values of the Ammonia Coefficient are set out below

CASE NO.	SEX	AGE	DATE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
				C	P	F	CALS.			
105	F	39	2/10/34 29/5/35 5/8/35	54 150 150	72 70 70	144 50 50	1800 1330 1330	None None None	7.9 4.7 3.9	This married woman had diabetes of over a year's duration. The value of the Ammonia Coefficient while on two types of diet is shown opposite. She responded well to treatment.
106	F	51	19/6/34 19/8/35	100 150	65 70	100 50	1560 1330	12 22	7.3 3.2	This married woman was sent to the clinic three months previously on account of diabetic symptoms. She was treated as an outpatient.
107	F	50	4/12/34 16/7/35	100 116	75 70	100 50	1600 1130	10 None	9.2 6.7	Six months before the first estimation this married woman had been admitted to hospital for a gynaecological operation. She was found to have diabetes and was sent to the clinic for treatment.

Appendix 4

CASE NO.	SEX	AGE	DATE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
				C	P	F	CALS.			
108	F	54	19/8/35 4/9/35	50 150	75 70	150 50	1850 1330	None None	7.5 5.6	This married woman had first noticed diabetic symptoms six months previously. She had been successfully treated as an outpatient.

APPENDIX 5

These patients had not had previous treatment. They were started on 8 to 10 (old) Lawrence Line Rations and subsequently changed to high C, low F diets. The average ammonia coefficient while on any type of diet is shown in a separate column.

CASE NO.	SEX	AGE	DATE	DIET C	DIET P	DIET F	DIET CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	AVERAGE AMMONIA COEFFICIENT	REMARKS
109	F	56	18/3/35	40	60	120	1480	None	7.8		This married woman had had symptoms of diabetes for about a year. Her treatment was commenced in the wards and was continued as an outpatient.
			19/3/35						7.6		
			20/3/35						6.9		
			21/3/35						10.3	8.4	
			22/3/35						9.0		
			23/3/35						8.8		
				150	70	50	1330	None			
			25/3/35						7.7		
			27/3/35						7.2		
			29/3/35						5.1	6.1	
			1/5/35						4.9		
			8/5/35						5.6		

Appendix 5

CASE NO.	SEX	AGE	DATE	DIET C	DIET P	DIET F	DIET CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	AVERAGE AMMONIA COEFFICIENT	REMARKS
110	F	58	25/3/35	40	80	120	1480	None	6.8		This married woman had had symptoms of diabetes of gradual onset during the previous six months. She responded well to treatment as an outpatient.
			27/3/35						8.4	7.8	
			29/3/35						8.7		
			8/4/35						7.4		
				150	70	50	1330	None			
			12/4/35						5.4		
			17/4/35						5.1		
			24/4/35						6.4		
			1/5/35						5.0		
			8/5/35						4.8		
			15/5/35						5.2	6.1	
			22/5/35						5.9		
			29/5/35						6.8		
			5/6/35						6.9		
			27/7/35						5.1		
				170	70	50	1410	None			
			7/8/35						5.4		
				190	70	50	1490	None			
			15/8/35						4.6		
			21/8/35						4.8		
				210	70	50	1570	None			
			28/8/35						5.6		
			4/9/35						4.7		

Appendix 5

CASE NO.	SEX	AGE	DATE	DIET C	DIET P	DIET F	DIET CALS.	INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	AVERAGE AMMONIA COEFFICIENT	REMARKS
111	F	37	17/4/35	40	60	120	1480	None	7.6		This married woman was sent up by her doctor some weeks previously on account of glycosuria. She was found to be diabetic and responded well to treatment.
			24/4/35						6.6	7.2	
			1/5/35						7.4		
				150	70	50	1330	None			
			8/5/35						7.7		
			15/5/35						7.4		
			29/5/35						4.7	5.6	
			5/6/35						2.8		
			27/7/35						5.3		
				170	70	50	1410	None			
			4/9/35						5.7		
112	F	60	24/4/35	50	75	150	1850	None	2.3		This married woman had come to the clinic suffering from diabetic symptoms of three months duration. She died 18 months later from "Haemorrhage in stomach."
			1/5/35						6.6		
			8/5/35						5.9	4.6	
			15/5/35						3.7		
				150	70	50	1330	None			
			22/5/35						4.6		
			29/5/35						3.7		
			5/6/35						3.2		
			27/7/35						4.2		
				170	70	50	1410	None			
			7/8/35						3.8		
				190	70	50	1490	None		3.9	
			15/8/35						5.1		
			21/8/35						2.9		
				210	70	50	1570	None			
			28/8/35						4.4		
			4/9/35						3.4		

Appendix 5

CASE NO.	SEX	AGE	DATE	DIET				INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	AVERAGE AMMONIA COEFFICIENT	REMARKS
				C	P	F	CALS.				
113	F	62	29/5/35	50	75	150	1850	None	11.6	9.5	A married woman who came complaining of symptoms of several months duration.
			16/7/35						7.4		
			23/7/35	150	70	50	1330	None	5.8		
			7/8/35						6.8		
			15/8/35	170	70	50	1410	None	7.9		
			21/8/35						5.9	6.2	
			28/8/35	190	70	50	1490	None	7.1		
			4/9/35	210	70	50	1570		3.9		

APPENDIX 6

The patients referred to in this appendix were all treated on high C, low F diets with low fruit content. Later a considerable part of the carbohydrate was given in the form of fruit. The subjects were kept for at least a week on any diet before the estimations were made.

CASE NO.	SEX	AGE	DATE	DIET					INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
				C	P	F	CALS.	FRUIT CONTENT			
114	F	57	17/3/36 23/3/36 10/5/36 31/5/36	150 170 190 190	70 70 70 70	50 50 50 50	1330 1410 1490 1490	Low Low Low High	None None None None	5.1 4.1 5.4 5.0	This married woman had diabetes of over a year's duration. She responded to treatment as an out-patient.
115	F	40	23/3/36 12/4/36 10/5/36	150 170 170	70 70 70	50 50 50	1330 1410 1410	Low Low High	None None None	5.7 5.5 5.5	This married woman, whose father had died of diabetes, had had symptoms of three months' duration. She was treated as an outpatient.

Appendix 6

CASE NO.	SEX	AGE	DATE	DIET					INSULIN IN UNITS PER DAY	AMMONIA COEFFICIENT	REMARKS
				C	P	F	CALS.	FRUIT CONTENT			
116	M	22	17/3/36	150	70	50	1330	Low	None	6.8	This young man had diabetic symptoms of over three months' duration. He was treated as an outpatient.
			23/3/36	170	70	50	1410	Low	None	4.4	
			10/5/36	264	70	50	1786	Low	None	6.2	
			31/5/36	264	70	50	1786	High	None	7.4	
117	F	56	22/1/36	150	70	50	1330	Low	None	10.3	A married woman who had diabetic symptoms of a few months' duration. Even with the high C, low F diet the Ammonia Coefficient remained high, and she was given, in addition, an alkaline mixture before the last two estimations were made.
			29/1/36	170	70	50	1410	Low	None	10.4	
			11/2/36	190	70	50	1490	Low	None	8.8	
			25/2/36	210	70	50	1570	Low	None	11.8	
			3/3/36	210	70	50	1570	High	None	8.9	
			10/3/36	210	70	50	1570	High	None	9.3	
			17/3/36	210	70	50	1570	High	None	10.7	
			22/3/36	210	70	50	1570	+ Alk	None	6.3	
			12/4/36	210	70	50	1570	+ Alk	None	7.9	

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